PLASTICS

AUGUST 1960

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

Teflon Extrusion Techniques

PVC Weathering Stabilizer

Acrylic-Polyester Reinforcements

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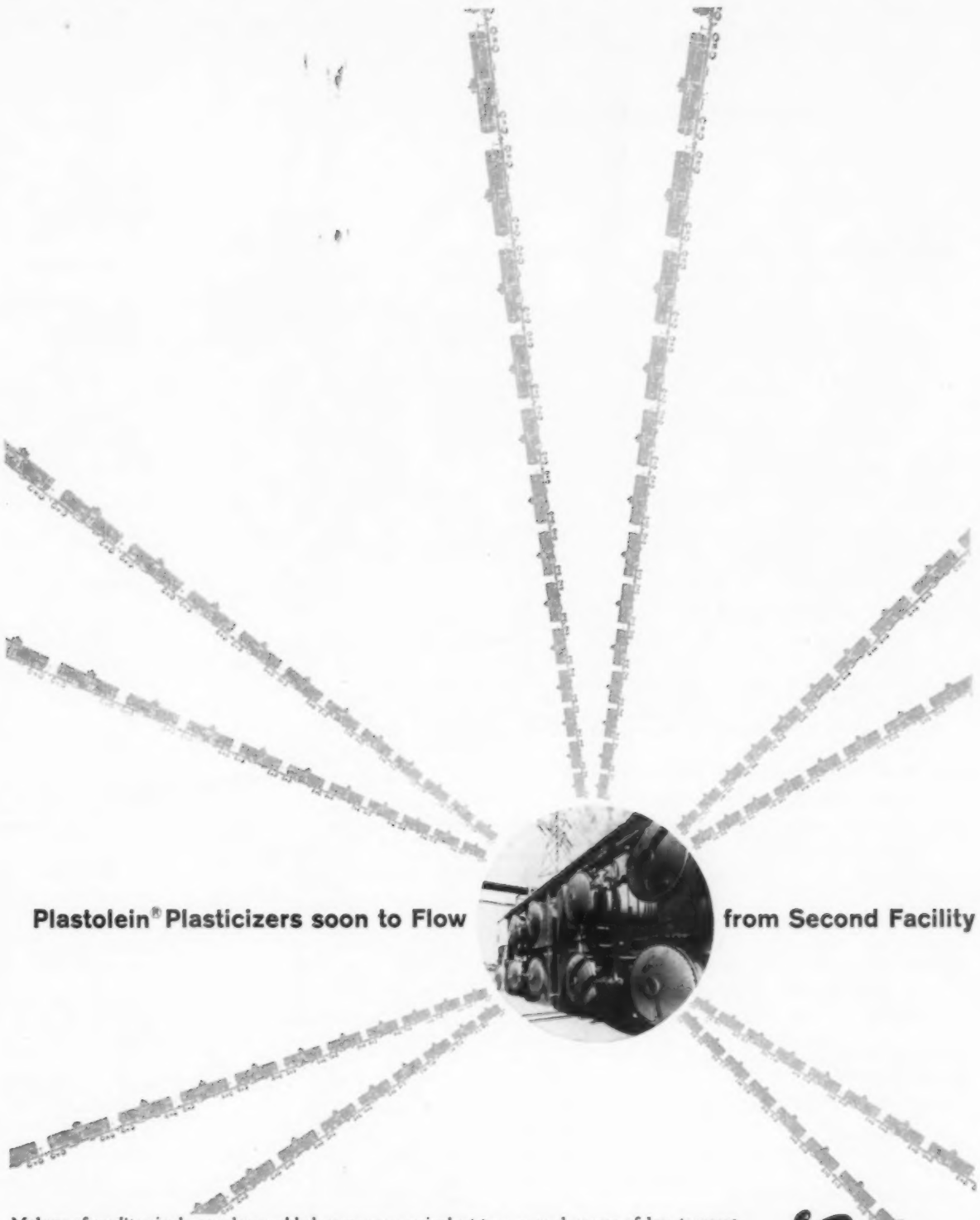

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Makers of *quality* vinyls now have added assurance equivalent to a second source of low-temperature and polymeric plasticizers as Emery will soon activate its new 6-million dollar ozone-oxidation and esterification plant. The new plant will increase several-fold the supply of azelaic and pelargonic acids and their esters. It is these two unique acids that give Plastolein Plasticizers their superior properties—properties that give vinyls lasting performance, warm feel, and the look-appeal required by makers of quality products. For more details on Plastolein 9058 DOZ, the best low temperature plasticizer available, and Plastolein 9720 Polymeric, the lowest priced, most versatile polymeric, write for our brand new 28-page Emeryfacts titled "Plastolein Plasticizers."

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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

August 1960, Vol. 6, No. 8

feature articles:

improved techniques for extrusion of "Teflon" 100 FEP-Fluorocarbon resin ..... p. 39

by J. A. BLAIR and H. J. HAON III

Production rates for smooth-surfaced wire coatings made by extruding this modified Teflon resin are far beyond those previously possible for the original fluorocarbon resin. At speeds higher than 300-600 feet per minute, melt fracture of the resin causes roughness because of excessive shearing of the resin as it flows through the extrusion die. This can be eliminated by increasing the die opening, or lowering the resin viscosity by keeping the resin as hot as possible. The latter can be done by raising the resin and die temperatures, and using radiant heaters and long cones to reduce orientation of the material as it leaves the extruder.

rockwell hardness scale comparison ..... p. 42

by CHARLES ANDREWS

An investigation of Rockwell hardness tests and hardness scales for plastics materials provides data of benefit in an over-all picture of plastics hardness. A chart is given for quick comparison of different Rockwell hardness in currently used plastics materials.

a new weathering stabilizer for poly (vinyl chloride) plastic ..... p. 45

by H. W. COOVER, Jr., R. L. McCONNELL, G. C. NEWLAND and J. W. TAMBLYN

Test results show that HPT is a light stabilizer of the type needed for thin films and fibers. Care is required in formulations to retain adequate heat stability by assuring that the stabilizer disposes absorbed energy in a manner that is completely harmless to the surrounding polymer molecules.

long-term durabilities of polyesters in glass-reinforced parts ..... p. 50

by A. L. SMITH and J. R. LOWRY

Long-term exposure tests of up to five years have demonstrated the superiority of the firm's acrylic-polyester over straight 100% acrylics in glass-reinforced constructions. Numerous experimental test results plus actual exposure-test installations are given in substantiation. This apparently anomalous behavior is analyzed carefully and explained.

guest editorial:

industrial design and the battle for material supremacy ..... p. 48

by D. E. SCOTT

engineering forum:

consultant's column ..... p. 55

by DR. S. S. STIVALA

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Eastman Chemical Products, Inc.

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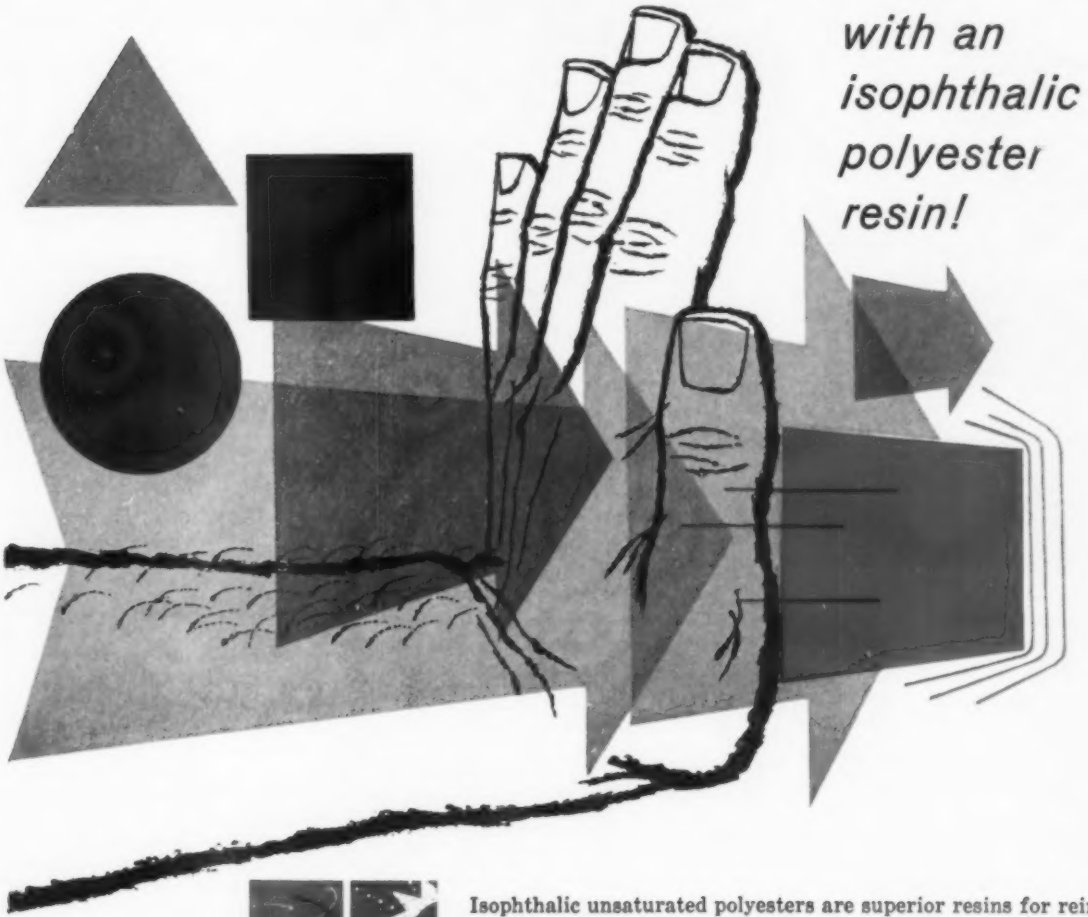

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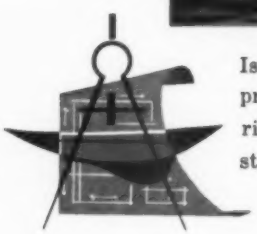

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Letters to the Editor

An Aroused "Egg-Head"

Dear Sirs:

Mr. Saunders' Guest Editorial on industrial publicity (April 1960) is a fine example of how some good and useful information can be clouded with an author's preconceived notions and prejudices. I started out by agreeing with the separation of technical and industrial publicity, but as I read how technical publicity is "for the . . . so-called egghead," how it consists of "outer-space technical pontificating (!)," and how it is "heavily larded," I found myself reluctant to read further.

But I went further, and actually learned something about what industrial publicity is, and how it works. I chuckled at seeing Mr. Saunders' fatherly warning against free publicity—while eagerly taking all he can get through this editorial!

I'm surprised at Mr. Saunders' attitude in the editorial, considering his profession. He should know enough to write for the reader, and know enough to discover that a large proportion of PLASTICS TECHNOLOGY readers are technical. What better way of not getting across than be making your readers mad in the first column? No, Mr. Saunders, we technologists are not all "Ph.D.'s writing to impress our brothers and peers." We are mostly sensible, practical people who happen to have learned a trade whose language you don't understand. And what's more, we've used that trade to make our lives, yours and mine, more meaningful and more enjoyable.

If you wish to provide publicity for us, we're all in favor, because we know that good publicity makes more sales, which in turn make more jobs and more profits. But please fit the publicity to the readers. Where the readers are housewives and musicians, stenographers and lawyers, of course you should keep technology to a minimum. But this is not because it is "not down to earth" or "heavily larded" but, rather, because it's just out of place. And when you have a technical audience (and it's a pretty big one), we'll both profit if you learn and speak our language.

PLASTICS TECHNOLOGY did well in publishing Mr. Saunders' editorial, even though they disagreed with it. After all, these are the people we live and work with. We'll never learn and appreciate each other's point of view, unless we communicate and try to explain ourselves.

Allan L. Griff
Union Carbide Plastics Co.,
Div. of Union Carbide Corp.
Bound Brook, N. J.

(Would any other reader care to express his thoughts on "publicity"?—Editor)

On Defining Elastomers

Dear Sirs:

I would like to register a strong objection to the definition proposed by J. P. McMahon in his guest editorial article in your June 1960 issue. His definition of an elastomer is as follows:

"An elastomer is a solid organic or inorganic polymer or copolymer having inherent and obvious extensibility and/or compressibility at room temperature on application of moderate stress; accompanied by immediate and approximate recovery to its original and undeformed dimensions when the stress has been removed."

All theories and facts relative to the properties of elastomers (excluding those with a gaseous content) are based on fluid relative incompressibility. Both the terms "extensibility and/or compressibility" as used in the proposed definition are functions of deformation and should be so stated.

I agree with Mr. McMahon's premise relative to the ambiguity or definition in the field of elastomers. However, I am sure we would all prefer ambiguity to simple inaccuracy.

Martin A. Usab, President
Dyna-Tech Plastics, Inc.
1225 W. Wakeham Ave.
Santa Ana, Calif.

We invite letters from our readers for publication in these colums. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identify of the writer will be withheld if desired.

—The Editor

Features for September

Fixed-Orifice Pressure Control for Extruders. B. H. Maddock, Development Scientist, Union Carbide Plastics Co., Bound Brook, N. J.

A simple, fast, and inexpensive method of determining whether the addition of a pressure control valve between the extruder screw and the forming die is practical. In some cases, the fixed orifice itself affords the solution, and an adjustable extruder valve is not needed.

•

Determining Unit Cost in the Molding Plant. D. A. Dearle, Plastics Div., Mgr., North & Judd Mfg. Co., New Britain, Conn.

Quality control without cost control is not sufficient to cut overhead costs. A watchful eye on labor costs will keep management informed of production efficiency and, therefore, profits and losses. Mr. Dearle presents a simple method for recording these statistics and evaluating them.

•

Tensile Impact Measurements on Reinforced Plastics. R. H. Calderwood and A. J. Bush, Materials Engineers, Materials Laboratory, Westinghouse Electric Corp., East Pittsburgh, Pa.

A test method is presented which picks up greater differences between materials than does the Izod impact test. Testing equipment is described, as well as specimen shape and preparation, and evaluation of results. Speed of loading is pointed out to be a critical factor, as are the needs for using different scale ranges and pendulum masses.

SPECIAL SECTION

Auxiliary Equipment for Blow Molding. T. C. Broadwell, Dow Chemical Co., Midland, Mich.

•

Auxiliary Equipment for Extrusion Machines. Lee J. Zukor, Engineering Editor, PLASTICS TECHNOLOGY.

•

PT's Comparative Data on 1960 Extrusion and Blow Molding Machines.

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PT's Classified List of Auxiliary Equipment for Extrusion and Blow Molding.

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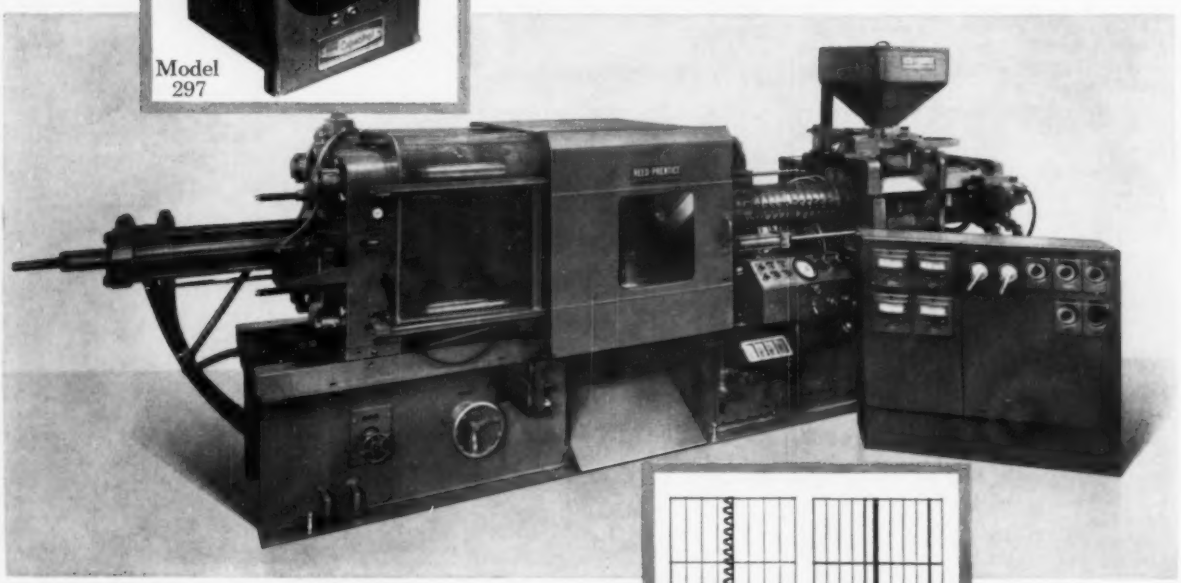
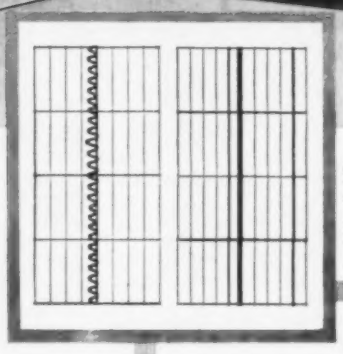
another Wheelco specification story...





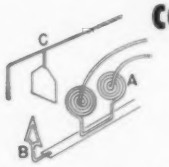
LEFT: Ordinary recorder with typical "on-off" control.

RIGHT: Wheelco "straight-line" Capaciline control.

Wheelco Capacitrols specified by Reed-Prentice for new Injection Molder

Reed-Prentice, another leading original equipment manufacturer for the plastics industry, has specified Wheelco Model 297 Capacitrols for their new 350TCL-12/16 oz. injection molding machine. Why is Wheelco the overwhelming choice for plastics instrumentation? *User advantages.* Look at Model 297 Capacitrols for example — users get fast, accurate temperature control because of Wheelco's "Electronic Link" no-contact control. Plug-in terminal panels permit easy servicing without dismantling the instrument. "Straight-line" control is provided by built-in Wheelco Capaciline control. A wide choice of temperature ranges for plastics applications is offered. Thermocouple break protection can be supplied as an optional feature. Whether you are a plastics OEM like Reed-Prentice, or a user of plastics machinery, you can increase the efficiency of your equipment with Wheelco instrumentation. Contact your nearest Wheelco sales and service office for complete information. Wheelco has a complete line of process-control instrumentation to fulfill your requirements.

Wheelco "Electronic Link" control



Wheelco "Electronic Link" provides safe, accurate "no-contact" control with no instrument lag. The frequency of an oscillating current flowing between two coils (A), which are mounted on the temperature setting lever (B), is changed when the metal flag (C) is moved by even a slight temperature change. Relay contacts are thus activated providing operation. This simplified design means little, if any, maintenance.

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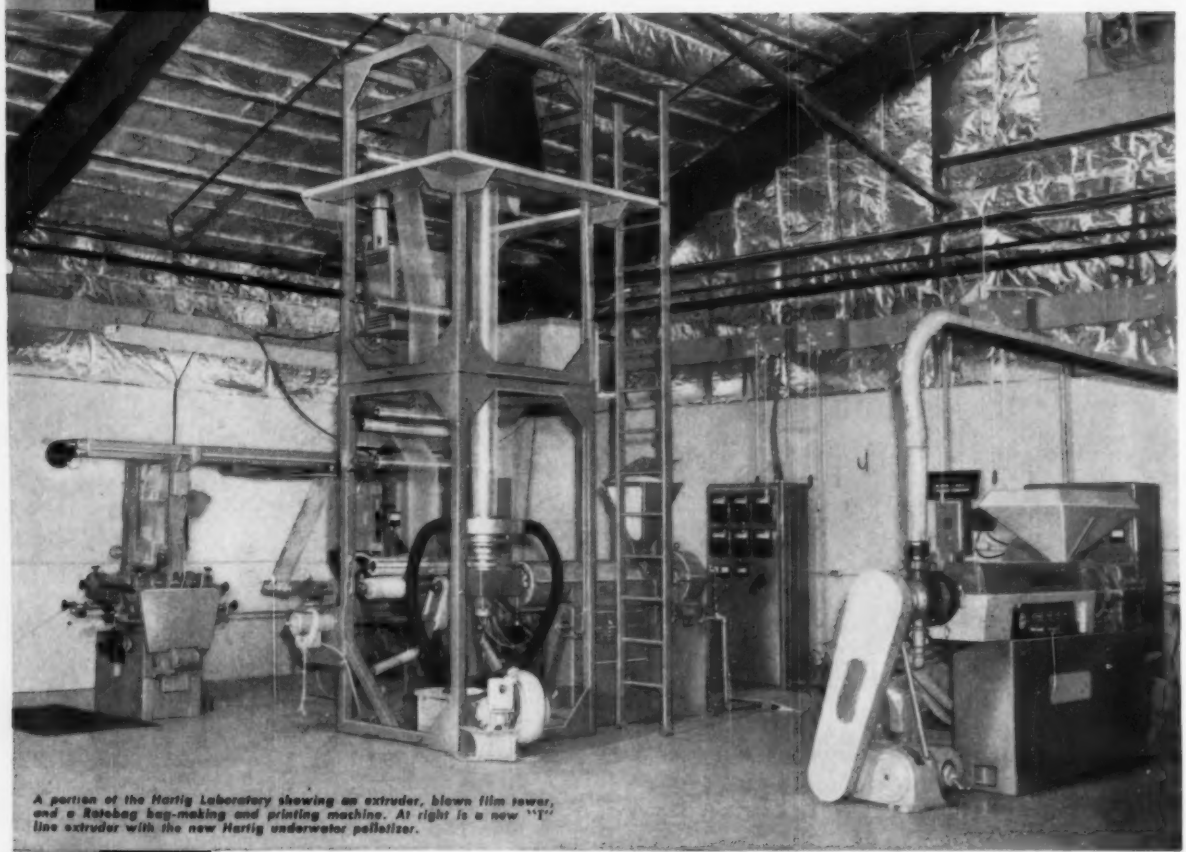
the Hartig Laboratory is your laboratory for pre-production testing of extrusion processes and equipment . . .



A portion of the Hartig Laboratory showing an extruder, blown film tower, and a Rotobag bag-making and printing machine. At right is a new "I" line extruder with the new Hartig underwater pelletizer.

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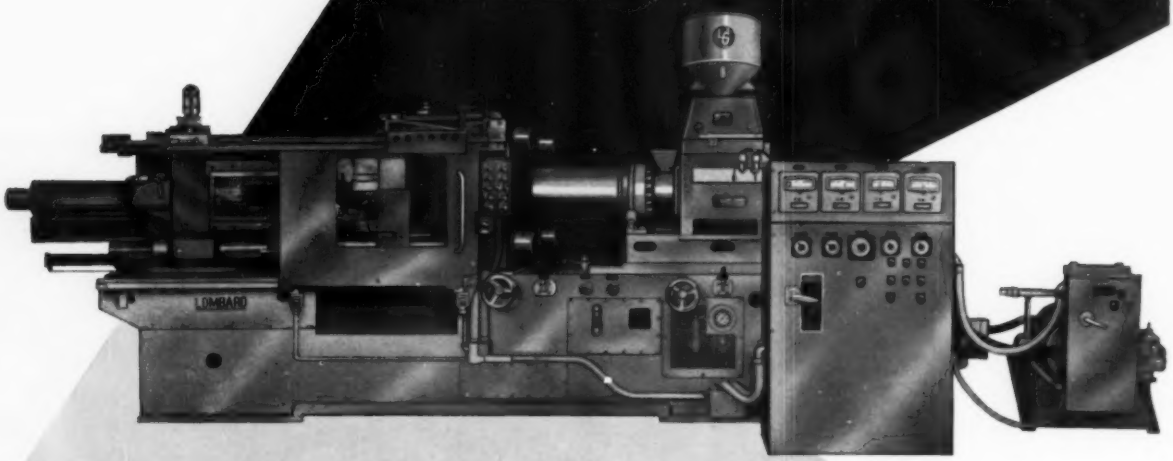

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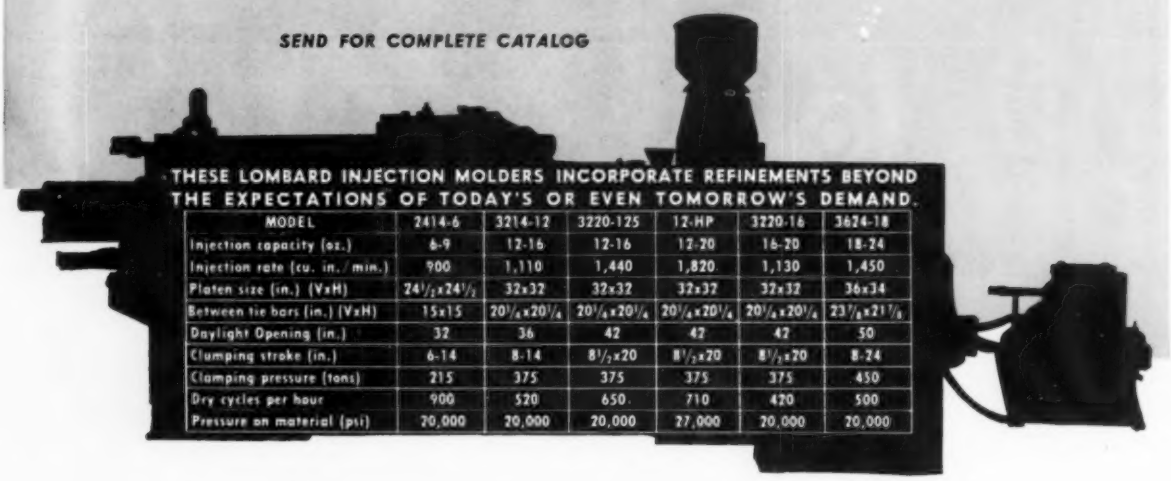

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Between tie bars (in.) (VxH)	15x15	20¼x20¼	20¼x20¼	20¼x20¼	20¼x20¼	23⅞x21⅞
Daylight Opening (in.)	32	36	42	42	42	50
Clamping stroke (in.)	6-14	8-14	8½x20	8½x20	8½x20	8-24
Clamping pressure (tons)	215	375	375	375	375	450
Dry cycles per hour	900	520	650	710	420	500
Pressure on material (psi)	20,000	20,000	20,000	27,000	20,000	20,000

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Morflex 300 — Di Iso Octyl Adipate. Imparts excellent heat, light and viscosity stability. This ester is used alone or in combination with other plasticizers, primarily to impart superior low-temperature flexibility.

Morflex 210 — Di-2 Ethylhexyl Sebacate. Contributes to PVC compounds such properties as: outstanding low-temperature flexibility, extremely low volatility, low extraction by soapy water, good viscosity stability in plastisols, good heat and light stability, very good electrical properties and excellent drape in PVC sheeting and upholstery.

Morflex X-1088 — Modified phthalate. Low cost—low-temperature properties equal to popular epoxies and compatibility is superior.

Morflex X-1125 — Di Tridecyl Phthalate. Increasingly popular plasticizer for high-temperature compounds.

Morflex 410 — Dioctyl Azelate. An excellent low-temperature plasticizer with good compatibility.

Morflex X-1114 — Di Cyclohexyl Azelate. This cyclic-containing ester has many possibilities over a wide field. Low temperature. Good solvation.

Morflex X-1118 — Acetyl tri-n-octyl/Decyl Citrate. A new material with combination properties of low temperature and low volatility. Possible uses include "non-fogging plasticizer."

Morflex P-50A — Polyester type. A 3,000-molecular weight plasticizer with outstanding gasoline and aliphatic solvent resistance.

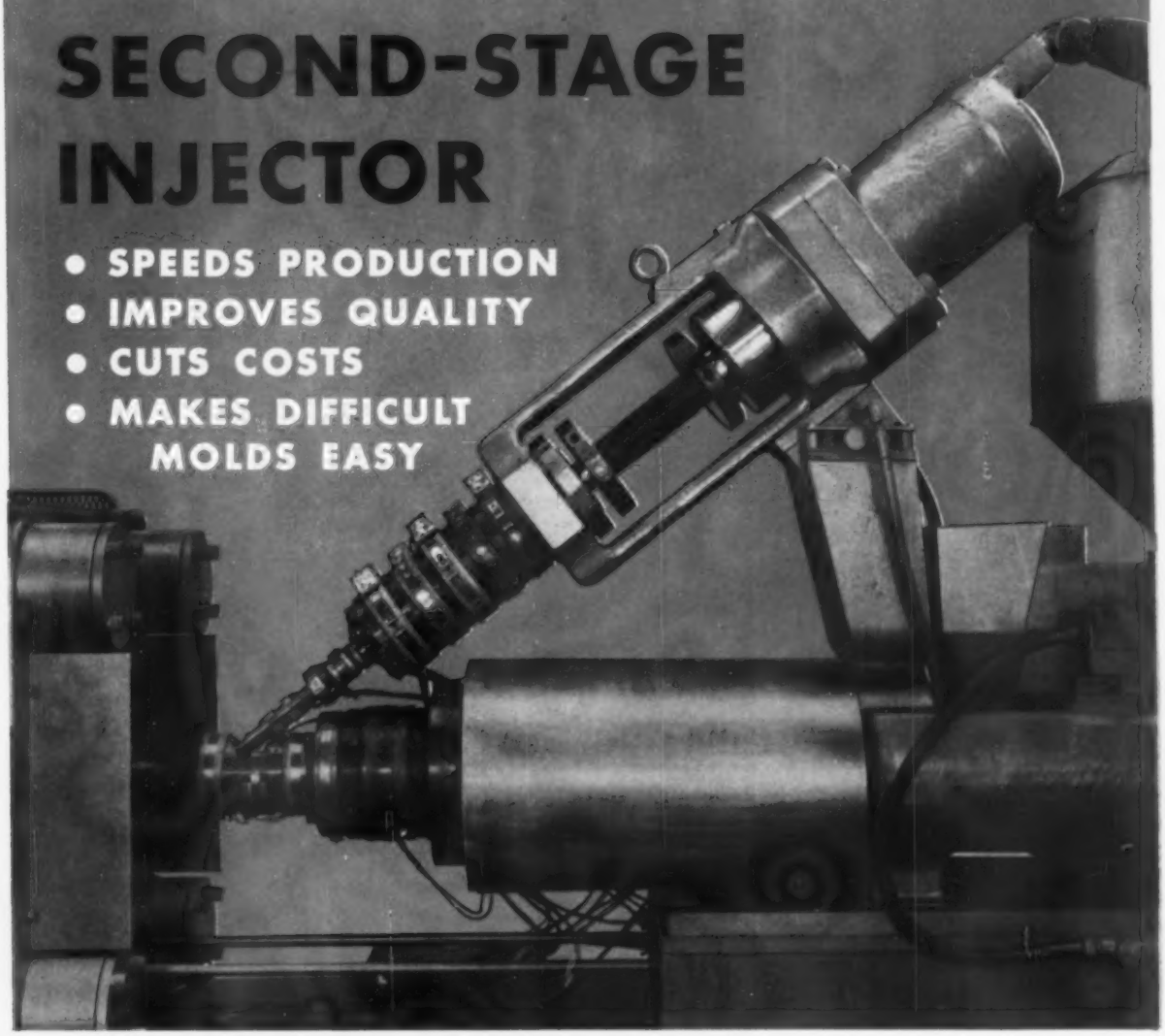
ALSO AVAILABLE ON REQUEST — CUSTOM-TAILORED PLASTICIZERS AND ESTERS ... to fit specific applications.

Write for further information, today!

CHAS. PFIZER & CO., INC., CHEMICAL SALES DIVISION
PLASTIC & PLASTICIZER DEPT., 630 Flushing Avenue, Brooklyn 6, N. Y.

IMPCO'S NEW SECOND-STAGE INJECTOR

- SPEEDS PRODUCTION
- IMPROVES QUALITY
- CUTS COSTS
- MAKES DIFFICULT MOLDS EASY



The Second Stage Injector was designed to increase the effective operation of any Impco Injection Molding Machine now in service. It is also now available as standard equipment on new Impco machines. Its use gives you:

- Raw material savings
- Increased capacity
- Reduced molding pressures
- Increased mold area
- Simplified nylon molding
- Fewer rejects

Ask for Bulletin P-127 for more information.

IMPCO®

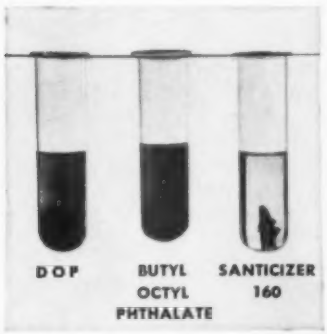
IMPROVED MACHINERY INC.
NASHUA, NEW HAMPSHIRE

MANUFACTURERS OF IMPCO PLASTIC MOLDING MACHINES

Better performance, faster processing, and attractive cost make

SANTICIZER 160 ...THE ONE PLASTICIZER NO VINYL FLOOR TILE SHOULD BE WITHOUT

Santicizer 160 gives you... IMPROVED PROPERTIES IN TILE



SANTICIZER 160 shows low migration to asphalt by insignificant pickup of black color from asphalt-impregnated felt, can prevent buckling of tile by migration to adhesive.

Staining tests show that SANTICIZER 160 provides best resistance to asphalt staining and the other big troublemakers like mustard, catsup, lipstick, tar, and kitchen grease.

If you want to stop customer complaints about staining, loss of adhesion, and buckling of tile by plasticizer migration to adhesive, use SANTICIZER 160. Even if your own adhesive works satisfactorily, you can't be sure a customer will use *your* adhesive with *your* tile. When you use SANTICIZER 160, you'll also boost consumer acceptance with these added benefits:

"Three-dimensional" gloss • High abrasion resistance • Excellent dimensional stability • Good resistance to extraction and hydrolysis

FASTER, MORE ECONOMICAL PROCESSING

	PROCESSIBILITY			FILLER TOLERANCE					
Plasticizers	Time to reach 280° F.	Plasticity on roll mill	Tack	Plasticity with fillers (parts filler) 100	115	125	Tack with fillers (parts filler) 100	115	125
SANTICIZER 160	2 min., 3 sec.	E	E	E	G	F	E	G	F
DOP	2 min., 35 sec.	VG	G	VG	F to P	*	G	F to P	*
BUTYL OCTYL PHTHALATE (SANTICIZER 165)	2 min., 15 sec.	E	G	E	F	P	G	F	F

E—Excellent, VG—Very Good, G—Good, F—Fair, P—Poor. *Batch dropped from mill. Formulation available on request.

Step up production and cut down processing delays with SANTICIZER 160. Compare its advantages in processing with any other plasticizer...none can match these important benefits:

HIGH WETTING ACTION—allows higher filler use with homogeneous mixtures and best gloss

GOOD PLASTICITY AND FAST FUSION—for fastest processing

QUICK TACK—for easy milling, surface gloss, and roll retention (no fall-off)

UNIFORM RESULTS—for "leveling out" the effect of variations in processing

ATTRACTIVE COST THROUGH BULK OR BLEND PURCHASE

The many advantages of SANTICIZER 160 make it your best buy in floor-tile plasticizers. If your formulation calls for a plasticizer blend (such as SANTICIZER 160 with DOP, DIDP, or SANTICIZER 165), Monsanto *custom blends* in bulk offer you these important advantages:

- You can reduce ordering, handling, storage, and blending expenses
- You achieve standard, uniform mixtures and eliminate chances of weighing errors, contamination, spillage
- You obtain the lowest bulk price on ingredients

Conserve your working capital by blend service from Monsanto. Monsanto stocks floor-tile plasticizers at *six* bulk stations, *13* warehouses, and *two* plants. They're located for fast delivery to your plant.

For more information or a SANTICIZER 160 sample, contact your Monsanto representative.

For information on custom blends or a technical evaluation of your formulation, write:

"Plasticizer Council"
Monsanto Chemical Company
Organic Chemicals Division
Dept. PL-4, St. Louis 66, Mo.

Monsanto®

SANTICIZER: Monsanto T. M. Reg. U. S. Pat. Off.

ONLY SANTICIZER 160 GIVES YOU ALL THESE ADVANTAGES IN VINYL FLOOR TILE

What's new in processing

Acoustical control in luminous ceilings is reported with Soundsheet, a rigid vinyl sheeting available from Contrex Co., Chelsea, Mass. The sheet is perforated with tiny holes and laminated on both sides to thin layers of paper which have been saturated with Geon vinyl latex. Fibre Leather Mfg. Co. offers the saturated paper. The latex-paper imparts added flame resistance and light stability, while providing tiny sound traps at the points of perforation.

Corrosion resistance can be imparted to metals, wood, and concrete by spraying with Fiberglas Flake, a product of Owens-Corning Fiberglas Corp. Shear strength is reported at 800 psi., vapor transmission at less than 0.01 perms, and dielectric strength at 500 V/mil.

Spray coating of Penton, Hercules' chlorinated polyether, is a recent development of Pfaudler Co., Rochester, N. Y. Using Pfaudlon 301, an aqueous suspension of Penton, the firm is able to apply 20-40 mil coatings in two applications without preheating of parts. Surfaces should, however, be cleaned by sandblasting or other means and the water driven off to fuse the coating. Pfaudlon will be less expensive than the fluorocarbons, but more expensive than vinyl or rubber.

Abstracts

"Controlled Density Polystyrene Foam Extrusion" by F. H. Collins, SPE Journal, July, 1960, describes a continuous process for extruding foamed polystyrene.

"Cold-Plunger Molding of Thermosets" by A. M. Howald, SPE Journal, July, 1960, describes the process which is currently limited to fiberglass-alkyd compounds, but should be applicable to phenolics and melamines.

"Extruding Polypropylene Films" by A. R. Gilden and W. J. G. McCulloch, Modern Plastics, July, 1960, by two methods—chill roll and water bath. Each process yields film with slightly different properties.

"Fluidized Bed Coating with Vinyl" by R. J. Borsh, Modern Plastics, July, 1960, points out that the technique only looks simple. It goes on to point out how processing variables affect coating thickness and resin fusion.

"Problems and Trends in Injection Molding" by E. G. Fisher and W. A. Maslen, British Plastics, July, 1960, discusses screw plasticizing units, mold locking units, and the design and construction of molds.

"Injection Molding of Acetal Resin" by G. F. C. Barrett, British Plastics, July, 1960, covers equipment and estimating, mold design, molding operations, and annealing.

"Injection Molding of Polypropylene" by L. Griffiths, British Plastics, July, 1960, includes machines, mold temperatures, pressure and rate of injection, injection time, gate size, and problems encountered in the actual molding.

Patents

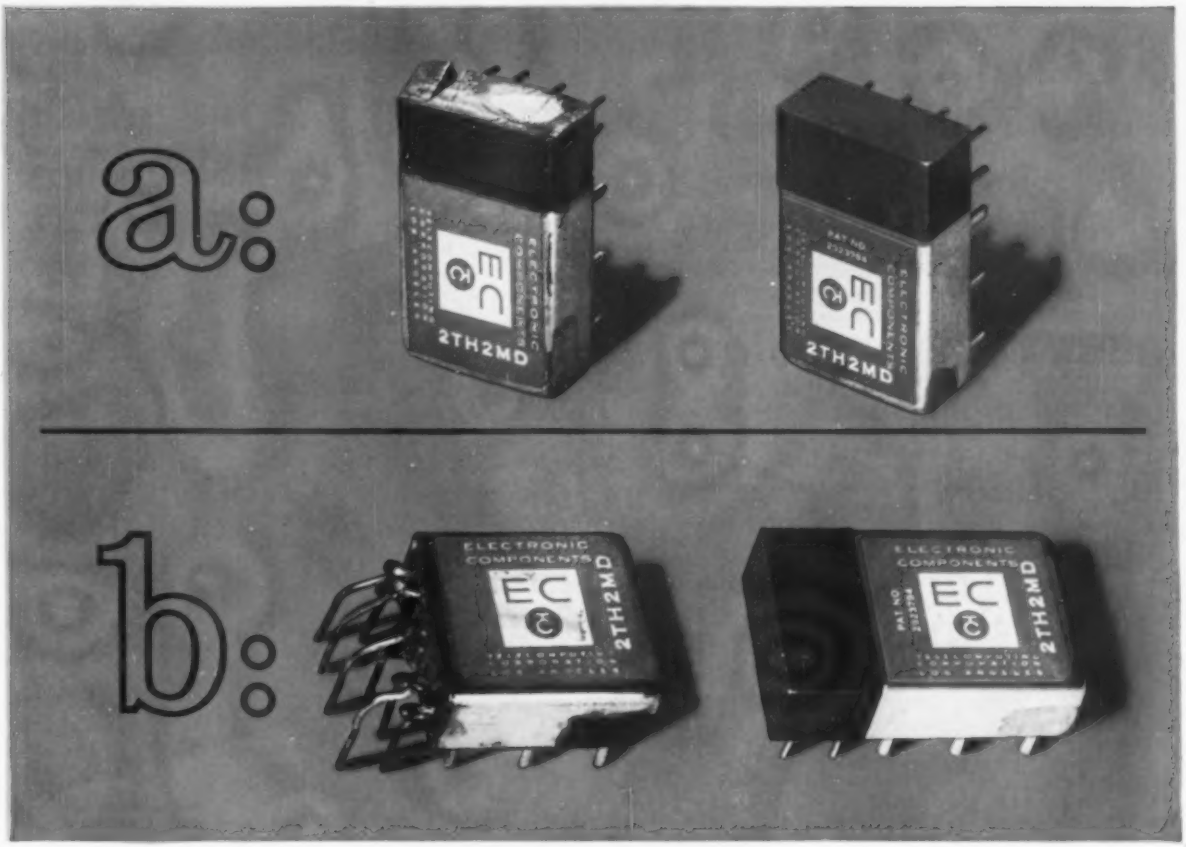
2,891,284 to Union Carbide Corp.—a method for molding objects of nonuniform thickness by placing uncured material in a mold having at least one wall with at least one hollow core. Cure is effected through radio frequency electrical energy.

2,891,280 to U. S. Products Corp.—a method for forming hollow articles from thermoplastic sheet. This sheet is heated and the rim of the hollow article is formed mechanically. This holds the sheet as it is drawn down into the mold.

2,890,491 to Tube Turns Plastics—a process for injection molding unplasticized PVC, including intermittent delivery of successive material charges.

2,888,954 to Harry F. Gates—a method of laminating plastic pipe actually involves extruding one grade of polyethylene onto another to form a two-layer piping.

DOW | THERMOSETTING RESINS



TESTS PROVE DOW EPOXY NOVOLAC

outperforms conventional epoxies under extreme stress!

Potting relay terminal connectors for the guidance system of one of America's new missiles, a major electronic component manufacturer made a series of torture tests . . .

TEST a: To determine the effects of prolonged heat on two terminal relay potting formulations—one a high quality conventional epoxy resin, the other, Dow Epoxy Novolac (D.E.N. 438). Both were placed in a 180°C. oven. After five hours, the conventional epoxy resin potting cracked. But after 100 hours of continuous 180°C. heat, the potted terminal made from Dow Epoxy Novolac was unharmed!

TEST b: To compare the ability of each potting to withstand the action of high-powered degreasing solvents. The ordinary epoxy resin formulation was completely dissolved after only 48 hours in the stripper. But the potting made from D.E.N. 438 showed no significant change, even after two weeks' immersion in the same solvent!

RESULTS: Proof once again that for potting, molding, encapsulating, laminating electronic components, or for any application where performance is critical, Dow Epoxy Novolac resins can provide the extra measure of physical and chemical stability necessary for success.

New applications for the Dow family of thermosetting polymers are being uncovered every day. If your application could benefit from their hardness, toughness, dimensional stability, and chemical resistance, call your nearest Dow sales office. Or write: THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Merchandising Department 1966DT8.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

INTRODUCING
NUOSTABE 983

A new development in vinyl stabilizers for plastisols and organosols

Nuodex has taken the lead in offering a stabilizer combining superior performance with excellent economy for plastisols and organosols in many applications.

Nuostabe 983 can be used for the spread coating of fabric and paper . . . for laminating film to fabric and film to paper . . . for dipping compounds in treating gloves, wire, etc. . . . for stabilizing organosols for the clear top coat of printed floor coverings.

Completely free from sulfide-staining, Nuostabe 983 remains stable far longer under temperatures normally required in laminating. And in certain applications, Nuostabe 983 can be used effectively even without epoxy plasticizers.

With Nuostabe 983, Nuodex has introduced a new metal organic stabilizer to converters and laminators. And, as with all other Nuodex products, Nuostabe 983 is QUALITY CERTIFIED to assure consistent quality and purity of product.

For samples and complete technical data on Nuostabe 983 write

NUODEX special purpose chemicals for industry

NUODEX PRODUCTS COMPANY • ELIZABETH, NEW JERSEY

A Division of Heyden Newport Chemical Corporation

Fungicides • Nickel Salts • Organic Peroxides • Paint Additives • Stearates • Vinyl Additives

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

Polyethylene handles for multi-trip refillable milk bottles as well as one-trip carriers for multi-unit packs of cans, bottles or jars, are now on the market.

Milk bottle handle

The milk bottle handles make half-gallon and gallon bottles easier and safer to carry and use.

The molded polyethylene multi-unit carriers, which can be used for beer cans, soft drink bottles and various grocery and household products, have a number of advantages over conventional carriers. Those cited for beer cans, for example: savings of 1 cent per six-pack; high-speed application of carriers—up to 1200 cans per minute; faster cooling when refrigerated; instantaneous product identification; quick stacking; containers easily removed; carrier unaffected by moisture; carrier easily discarded.

Multi-unit one-trip carrier

Polyethylene drum liners on a roll—heat-sealed at intervals and perforated just above the seal—have increased speed of lining corrugated cartons and drums threefold for one manufacturer. In the past, static electricity made the mouths of individual bags difficult to open; now, the tearing off action opens liners automatically. Photo shows workman pulling liner over mandril with one hand, while tearing it off roll overhead with the other. He'll simply flip both into drum, "cuff" the liner and remove the mandril.

Photo courtesy Bemis Bro. Bag Co.

Polyethylene bags in roll form have recently been introduced which will provide housewives with convenient containers for storing foods and other household items.

The prefabricated bags are packaged 25 to a roll in cartons similar to those used for waxed paper.

U.S.I. Introduces New PETROTHENE® Resin for Cast Film Extrusion

Produces "Soft Feel" Film of Exceptional Clarity and Gloss, High Stiffness

U.S.I. has developed a new 0.933 density polyethylene resin designed for cast film extrusion applications. The new resin – PETROTHENE 218 – has excellent processing characteristics and produces cast film with properties particularly suited to overwrapping soft goods, bakery products or paper.

Cast polyethylene film is an ideal packaging material for a virtually limitless number of consumer products.

Ultra-clarity is a key characteristic of cast film made from PETROTHENE 218. In transmittance and gloss, it equals or surpasses any other polyethylene film in the field. Haze is very low. Moreover, the film is easy to handle on overwrap equipment because of its high stiffness and good heat sealing properties.

For bakery goods, film made from PETROTHENE 218 is ideal. Its "soft feel" imparts a feeling of warmth and freshness, while its natural moisture barrier keeps products fresh longer. Clothing, too, takes on a soft-to-the-touch appearance not possible with "hard finish" overwrap materials.

Easy To Process

The new resin has a density of 0.933 and a melt index of 3.0. Its melt flow and hot-melt extensibility characteristics are excellent, permitting high haul-off rate (>200 ft/min) and relatively thin-gauge films (0.5 mil).

Extrusion stock temperatures of 450° to 550°F and casting roll temperatures of 80° to 170°F have been successfully used. Normally, of course, the highest stock and casting roll temperatures possible under given operating conditions will result in best-quality film.

Printability of films cast from PETROTHENE 218 is excellent. Film has been treated for printability in line with the extrusion process at rates of over 150 ft/min. With a moderate treat level, excellent ink adhesion has been obtained.

The resin is available in three formulations with varying slip levels: unmodified PETROTHENE 218, no slip; 218-26, medium-low slip; 218-27, medium slip.

Polyethylene-Lined Pails Now Used For Shipping Chemicals

Seamless blown-in-one-piece polyethylene liners for steel pails have been developed as another advance in solving the problem of safe and economical packaging of corrosive liquids. This container is expected to find wide application in packaging and shipping products such as acids and alkalies, food concentrates, photographic chemicals, electrochemicals and insecticides.

One-piece polyethylene liner insert permits use of steel pails for shipment of corrosive chemicals. (Photo courtesy Jones & Laughlin Steel Corp.)

The liner is blow-molded of polyethylene in the same manner as a "squeeze bottle," and is then attached to the cover of the outer steel container at the pouring opening, before it is inserted in the container. Its one-piece construction is said to insure against leakage and product contamination.

New Help in Selecting Best Polyethylene Film to Use

A revised edition of the 4-page brochure, *Which Polyethylene Film Should I Use*, incorporating the new Commercial Standard CS227-59 for Polyethylene Film has just been issued by U.S.I. The brochure lists film requirements and resin types suggested for 33 classes of packaged goods, in the terminology used in the new Commercial Standard.

The new U.S.I. brochure provides extruders with an easy-to-use reference to the principal applications of polyethylene film as defined in the new Standard and suggests applicable PETROTHENE resins for these uses. Copies may be obtained by writing to Technical Literature Department, U.S. Industrial Chemicals Co., 99 Park Ave., New York 16, New York.

Cast 1.25 mil polyethylene film from regular production run using PETROTHENE 218 resin.

DO YOUR CUSTOMERS . . . AND YOURSELF . . . A SERVICE SHOW THEM THIS CLARITY AND GLOSS

It's cast polyethylene film made from U.S.I.'s new PETROTHENE® 218 resin – ideal for overwrap for bakery products, soft goods, paper products; ideal to process.

With U.S.I.'s new resin for cast film extrusion you get clarity, gloss, and freedom from haze that no other overwrap can surpass.

On the shelf, products overwrapped with cast film from PETROTHENE 218 have a sales-spurring sparkle. And when a shopper reaches, she's completely sold – the film's "soft feel" imparts a feeling of warmth and freshness to bakery products . . . a feeling of softness to clothing that "hard finish" overwraps can't suggest.

For your customers, this superior film means more sales, fewer returns, greater economy. Strong and resistant to moisture and grease, cast polyethylene film also has high stiffness; this makes it easy to handle on overwrap equipment designed or modified to handle polyethylene film. It's easy to print, easy to heat seal. And cast polyethylene gives the packager all the economy of polyethylene film – the least expensive transparent wrap on the market.

In your plant, PETROTHENE 218 (density, 0.933; melt index, 3.0) makes the grade too. It has excellent melt flow and hot-melt extensibility properties which permit high haul-off rates (>200 ft./min.) and relatively thin-gauge films (0.5 mil). It has been treated for printability in line with the extrusion process at rates exceeding 150 ft./min. At moderate treat levels, ink adhesion is excellent.

PETROTHENE 218 is available in three formulations of varying slip level: PETROTHENE 218, unmodified no slip; 218-26 – medium-low slip; 218-27 – medium slip.

For more information or for technical assistance in providing your customers with all the advantages of overwraps made from PETROTHENE 218, contact U.S.I.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

NEW! "XL-modified" NLC Stabilizers upgrade performance of proven vinyl insulations

Aid color, simplify processing, too!

Today, everyone from the electrical contractor to the missileman wants to cram more power through wire with thinner vinyl insulation. This means the manufacturer must continue to produce better and better vinyl insulation.

Now, from National Lead Stabilizer research, comes word of a significant development in this direction . . . a modification applicable to five of the eight National Lead Stabilizers widely used for insulation. These are DYTHAL®, DYPHOS®, LECTRO® 60, TRIBASE* and TRIBASE-E* Stabilizers.

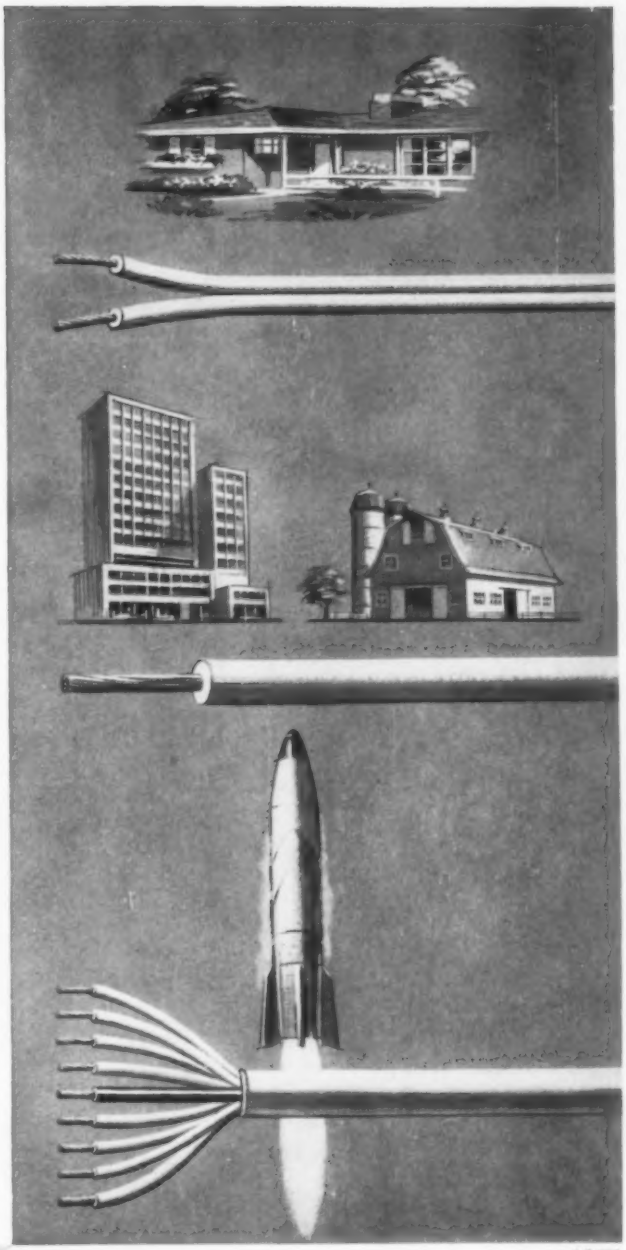
This modification greatly improves the effectiveness of the stabilizer in dielectric vinyl compounds and raises the performance level of the insulation. To designate the modified stabilizer the letters "*XL*" are used. For example, the modified *Tribase Stabilizer* is *Tribase XL Stabilizer.*

The new "XL" Grade Insulation Stabilizers call for no changes in proven formulations, yet with them, the *performance* of your proven formulations can be markedly improved.

The "XL" Grade Insulation Stabilizers produce the following improvements:

1. **Increase heat stabilizing action.**
2. **Increase retention of desired physical properties in the insulation during heat aging.**
3. **Improve natural color of compound both initially and after processing and aging.**
4. **Step up on-wire electrical resistivity.**
5. **Ease processing . . . particularly extrusion.**

Information on the new "XL" Grades is provided in a new NLC data sheet. If you would like a copy, simply let us know with the coupon below.



National Lead Stabilizers for Vinyl Insulations
(➤ indicates stabilizers available in both standard and "XL" grades)

- ➤ DYTHAL® Stabilizer for all classes up to 105°C primary insulations.
- ➤ DYPHOS® Stabilizer for top-notch light-and-weather-resistant jacketing.
- ➤ LECTRO® 60 Stabilizer provides economy in 60°C and higher-rated vinyls.
- ➤ TRIBASE* Stabilizer is the quality heat stabilizer up through 90°C insulations.
- ➤ TRIBASE-E* Stabilizer is the general purpose heat stabilizer for primary insulation.
- LECTRO® 77 Stabilizer meets requirements up through 80°C insulations.
- LECTRO® 78 Stabilizer improves special high-temperature stocks including vinyl tapes.
- DS-207® Stabilizer-lubricant improves heat stability and extrusion characteristics.

*Trademark

National Lead Company: General Offices: 111 Broadway, New York 6, N. Y. In Canada: 1401 McGill College Ave., Montreal.

Gentlemen: Please forward your new data sheet on "XL" Grade National Lead Company Stabilizers for vinyl electrical insulations.

Name_____ Title_____

Firm_____

Address_____

City_____ State_____

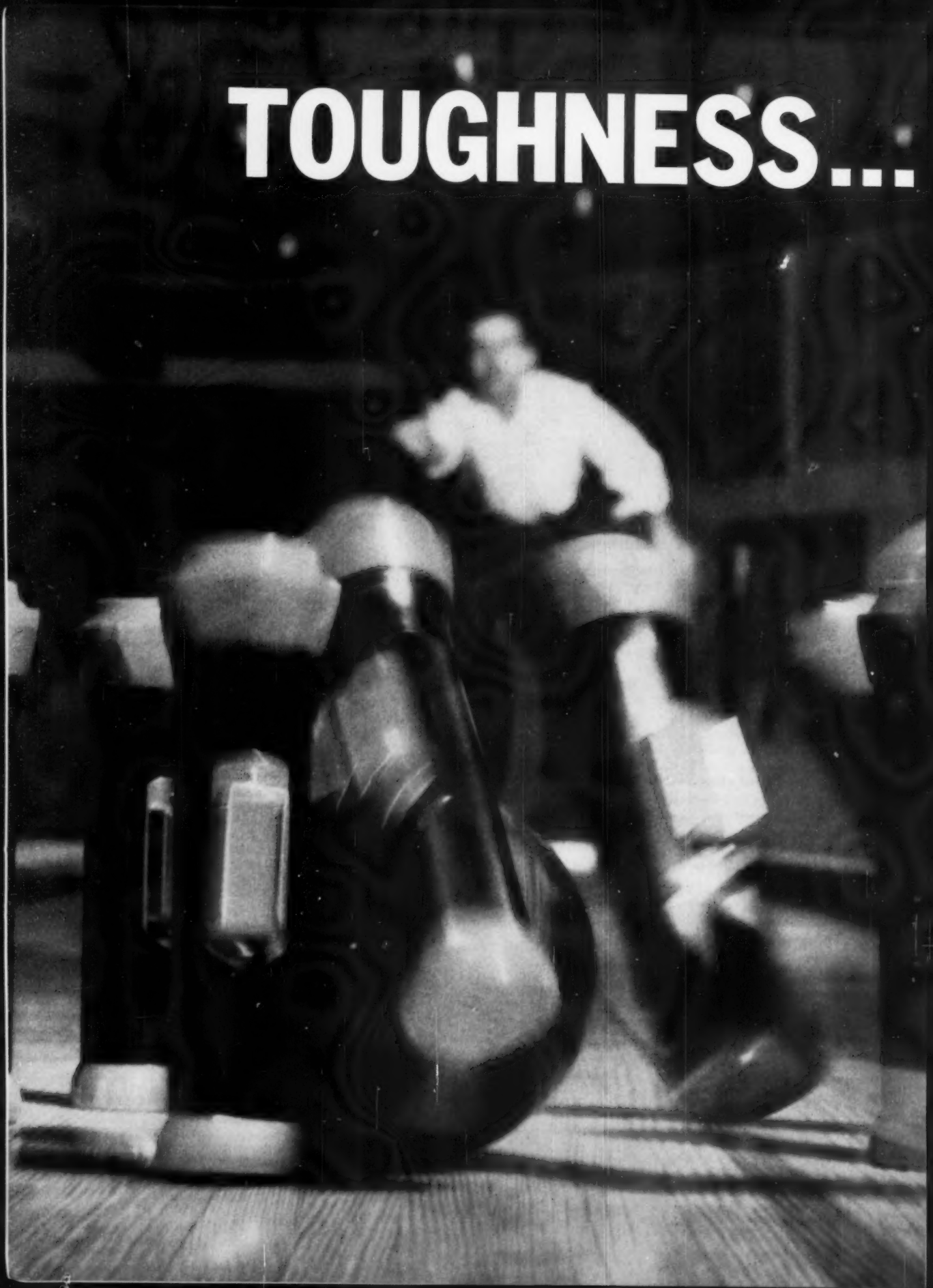
"XL" Grade Insulation Stabilizers

A Chemical Development of

National Lead Company

General Offices: 111 Broadway, New York 6, N. Y.

TOUGHNESS...



...another way high-density polyethylene IMPROVES YOUR PRODUCT

FLASHLIGHTS HAVE TO BE TOUGH, and these EVEREADY "Cordahide" flashlights have to be tougher than most because they're specially designed for heavy-duty shop use. That's why their cases, lens rings and end caps are molded from BAKELITE Brand high-density polyethylene DGD-6201. Laboratory tests have proved this material's exceptional resistance to impact and abrasion, and its performance in actual use confirms every laboratory finding.

In addition to toughness, BAKELITE Brand high-density polyethylenes supply the exact combination of strength, rigidity, surface appearance, stress cracking resistance, dimensional stability, and moldability you need.

In fact, if you need *any* type of polyethylene, you can choose from a full range of BAKELITE Brand materials . . . extending through low, medium, and high densities. The list also includes the remarkable new polyethylene copolymers—notable for low-temperature toughness, stress cracking resistance, and long flex life.

In choosing and using these materials for your product improvements, you can call on the broad Union Carbide knowledge and experience in the field of plastics development. Mail the coupon today, or write a description of your requirements directly to Dept. CU-185, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. *In Canada*, Union Carbide Canada Limited, Toronto 7.

TYPICAL PROPERTIES OF DMD-6201

	ASTM Test	
Density, gm/cc	D 792-50(A)	.950
Melt Index, gm/10 min.	D 1238-57T	8.0
No-Load Heat Distortion Temperature		128°C (262°F)
Secant Modulus (Stiffness), psi	D 638-58T	100,000
Tensile Strength, psi	D 638-58T	3300
Ultimate Elongation, %	D 638-58T	45
Tensile Impact (ft. lbs./cu. in.)		50

All physical tests conducted on samples with no orientation.

BAKELITE, UNION CARBIDE, EVEREADY and CORDAHIDE are registered trade-marks of Union Carbide Corporation.

UNION CARBIDE

EVEREADY "Cordahide" shop lites have the toughness to take the impact of a bowling ball, the hardwood alley, and one another—and still come up intact.

Dept. CU-185
Union Carbide Plastics Company
Division of Union Carbide Corporation
270 Brk Ave. New York 17, N. Y.

Please send me information on BAKELITE Brand high-density polyethylenes with particular emphasis on these properties . . . . . .

the application being considered is . . . . . .

Name _____

Firm name _____

Street _____

City _____ State _____

YOU NEVER MADE SO MUCH BEFORE !

Now, a superior way to increase the production and profits from compression or transfer molding presses

Thermall Preheaters are used by most compression and transfer molders. The reasons are simple! Thermall Preheaters (available in either standard or automatic models) not only represent a lower initial investment but also give superior performance. And superior performance means **increasing your production** while **decreasing your production costs.**

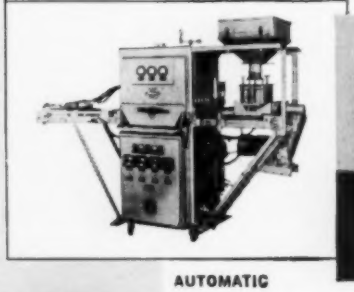
Because of its superior design, a Thermall Preheater will heat loose powder or preforms uniformly, quickly and economically and will give you day in and day out performance, around the clock, with the absolute minimum of maintenance.

With a Thermall you will get a reduction in rejects, be able to mold larger parts and increase production as much as 200% (such results have been reported from actual jobs).

YOU CAN RENT!

If you find that renting fits in better with your operation – rent one or more Thermall Preheaters.

Don't let another day go by without investigating this proven way to increase your production and profits, contact us now – put a Thermall Preheater in your plant on trial – see for yourself.



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AUTOMATIC HOOD

UPRIGHT

THERMALL

W. T. LaROSE & ASSOC., INC.

TROY
NEW YORK

DOW Plastiatrics
DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

ACCURATE STRAIN GAGE ANALYSIS OF PLASTICS REQUIRES VISCOELASTIC DATA

Strain gages are becoming increasingly important analytical tools for plastics engineers and designers. However, in using them to evaluate the behavior of plastics under conditions of stress and strain, designers have found that accurate interpretation of strain gage readings is possible only if the readings are related to other factors—notably, time, temperature and environment.

Because standard strain gages (both bonded wire and metal foil types) detect strain by changing electrical conductivity when bent or distorted in any manner, careful mounting on the test part is essential to accurate readings. Once secured to the surface of the test part, however, a gage will measure any strain imposed on the part, directly in micro-inches per inch of strain.

Plastics materials are viscoelastic and their moduli of elasticity are generally quite low compared with wood, metals, ceramics, etc. Because of this, strength characteristics are largely dependent on time, temperature, and the environmental conditions. Since variations in these three factors will affect strain gage readings, the relationships between the factors *must be known* for accurate interpretation. To assist designers, Dow Plastics Technical Service Engineers have developed much data on Dow plastics. An example of their use in stress analysis follows, taking data from Fig. 1.

A hypothetical part for a creep application will be made from Tyril® 767; an application which will subject the part to a constant load (P), producing an initial strain (ϵ_1) on the part. The imposed strain can be measured with a strain gage, then stress calculated using:

$$S_1 = \epsilon_1 E_1$$

where: S_1 = Initial stress, psi
ϵ_1 = Initial strain in micro-inches/inch (from the strain gage)
E_1 = Apparent modulus, psi, at 0.1 hr. (Fig. 2)

If $\epsilon_1 = 2800$ micro-inches/inch $= 2800 \times 10^{-6}$
$E_1 = 5.35 \times 10^5$

Then $S_1 = \epsilon_1 E_1 = 2800 \times 10^{-6}$ in./in. $\times 5.35 \times 10^5 = 1500$ psi.

The amount of creep for any given time can then be determined using:

$$\epsilon_c = \epsilon_2 - \epsilon_1$$

where: ϵ_1 = Initial strain reading
ϵ_2 = Strain reading at time "t"
ϵ_c = Amount of creep

Let $\epsilon_1 = 2800$ micro-inches/inch
$\epsilon_2 = 3200$ micro-inches/inch

Then $\epsilon_c = (3200-2800)$ micro-inches/inch $= 400 \times 10^{-6} = 0.0004$ inch/inch, the creep occurring at time "t".

One application of a strain gage to a plastics design problem is shown in Fig. 2. A freezer flip lid was studied to determine cause of breakage, the magnitude of stresses at failure, and at what period in the life of the part stresses were being imposed. Strain gages were bonded to critical areas of the flip lid, and measurements made of strain developed during assembly and actual service on the freezer. It was found that failure cracks (see Fig. 2) occurred because the mechanical and thermal applied stresses exceeded the design strength of the material. Further, the gages revealed that the stresses originated during both assembly and in service. The primary source of stress was discovered to be a rigid bond between metal and expanded plastic insulation. This prevented the plastic frame from acting independently, restricting its movement instead. The solution to the problem was self-evident, once the strain gages revealed the mode of stress development.

A few other applications of strain gages to plastics design and engineering problems are: measurement of coefficient of thermal expansion; measurement of Poisson's Ratio; elongation in test specimens; and stress analysis of bottle closures, home water filters, refrigerator parts, automotive parts, etc.

This study of strain gage applications is one of the continuing series of studies undertaken to assist plastics designers and engineers in the most effective selection and use of plastics materials. For information, and for data on Dow plastics materials, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1802D18.

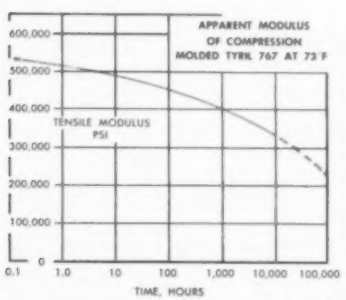

Fig. 1. Long-term data on Apparent Modulus of Tyril 767, for use in strain gage analysis.

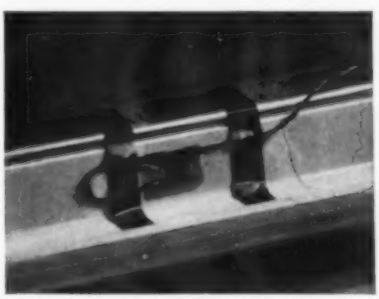

Fig. 2. Strain gage analysis of freezer lid reveals source of stress which caused failure.

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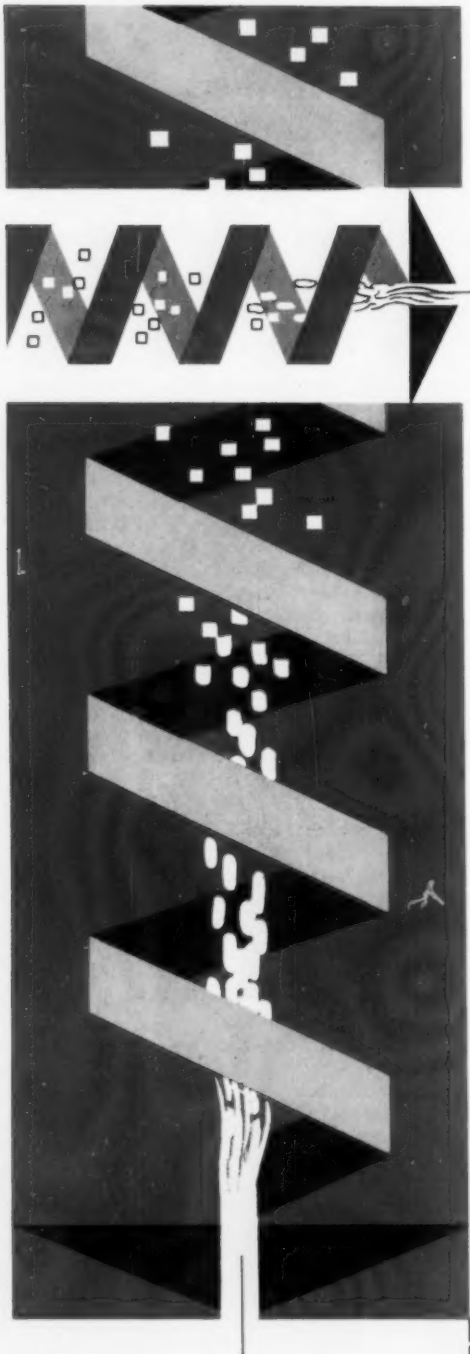

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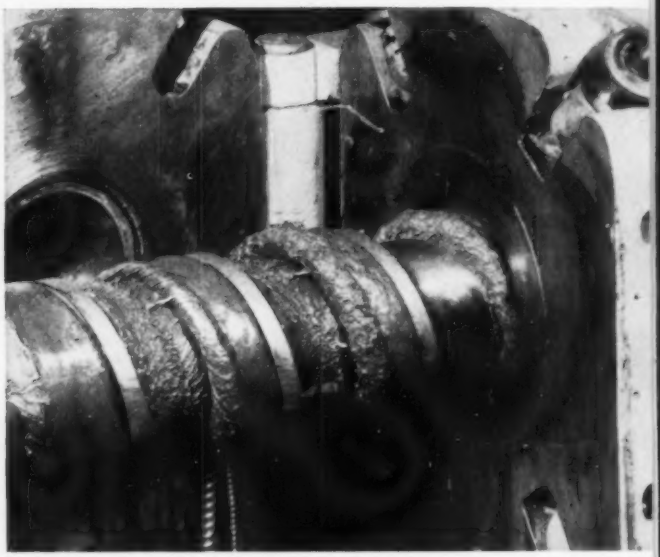
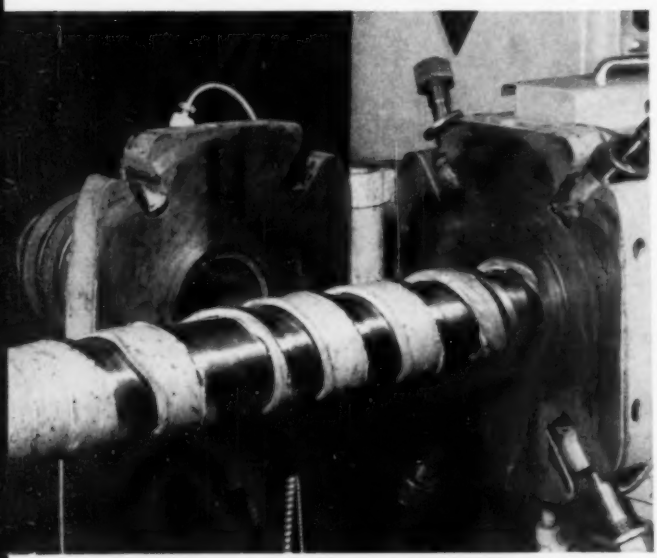
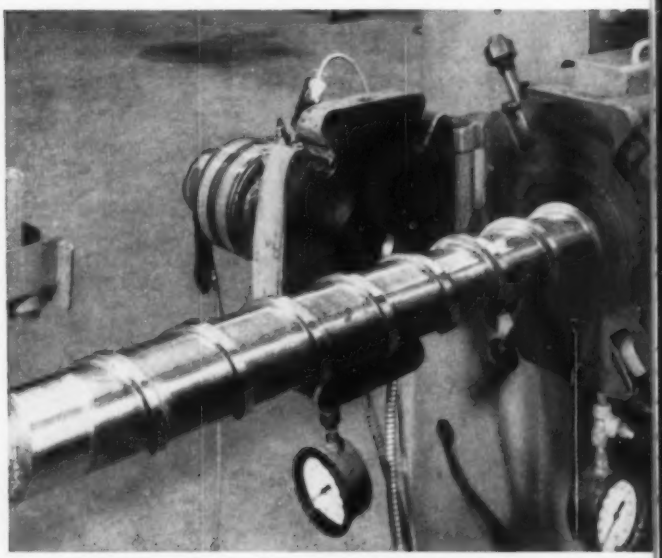


2. Operate machine to purge old material.



3. Note how A-C Cleaning Compound strips off easily.



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Editorial: PT Editorial Reorganization

In order to keep our readership informed and cognizant of all changes or developments in this publication, whether these changes are internal in our staff or external for the readers, we would like to bring to your attention the fact that we have just reorganized the editorial staff and make-up of the magazine. This reorganization program is designed to insure adequate and proper direction and planning for the publication, while still providing suitable and necessary attention to the many everyday details that go into putting out a regular monthly publication.

•

As major features of the reorganization, I am moving up from Editor to the post of Editorial Director, and Jim Dugan, our former Managing Editor, becomes the new Editor.

True, I will miss the excitement (and aggravation too) that are part and parcel of the Editor's "line duties", after serving in that capacity since the inception of the magazine back in 1955. On the other hand, the new position will give me the needed time to plan the editorial direction of the publication.

I will still be in direct charge of all future special issues (both planning and implementing them), as well as other special features that are begun or continued in the magazine. Now, when working on a machinery special issue and its involved and lengthy tabulations, I will not be distracted by coping with the continual problems that arise to plague the Editor.

My new position will also enable me to plan and carry out other proposed new ventures for our company, such as publishing books related to the activities of the plastics industry and our readership.

As Editor, Jim Dugan assumes all my former "in line duties", with all of their privileges and problems. He takes over all work with the Editorial Advisory Board, the various Engineering Forums, and the annual articles on Advances in the Technology of Plastics. These, plus the regular duties of editing all articles, and the other tasks that are the Editor's. Naturally, I will still be on hand to advise and assist Jim in his new position.

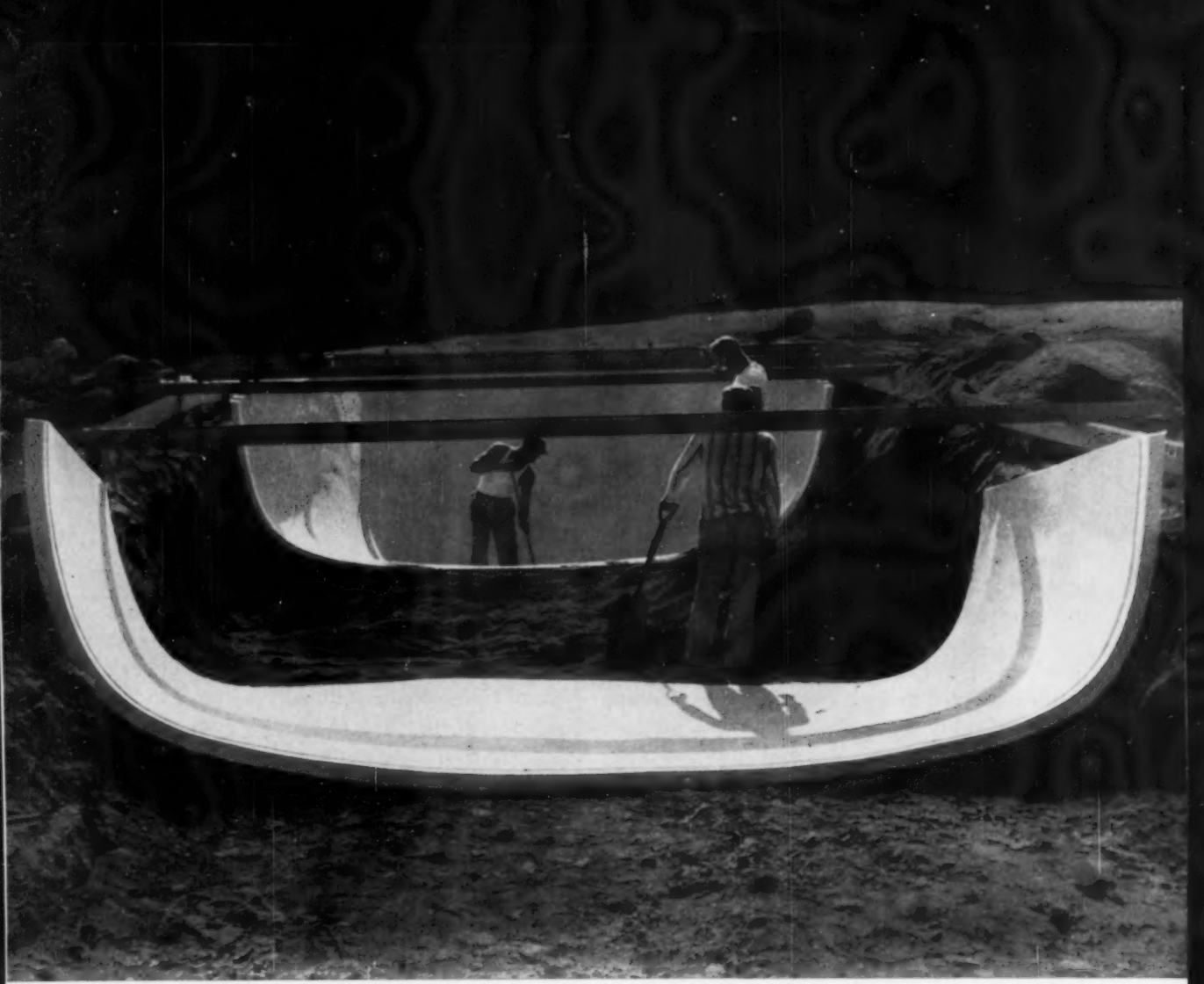
From time to time, our Executive Field Editor, John Caldwell, will be calling on you to discuss the status of the magazine and obtain your suggestions on what could be done to further PT's value and usefulness to you.

Going further down the editorial line, the other members of our editorial staff have had their duties reorganized to permit them to spend more time out in the field. Thus, everything in the reorganization program is designed to result in a better publication for the industry and our readership.

•

Before leaving the former post of Editor, I would like to express my appreciation for the many courtesies I received, as well as the many comments and suggestions (both written and telephoned) from the readers. They did much to make my job more interesting and enjoyable. I trust this assistance from all of you will continue under Jim, the new Editor. In my new title, suggestions or ideas for the future course of the magazine are earnestly invited from everyone.

Arthur M. Merrill
Editorial Director



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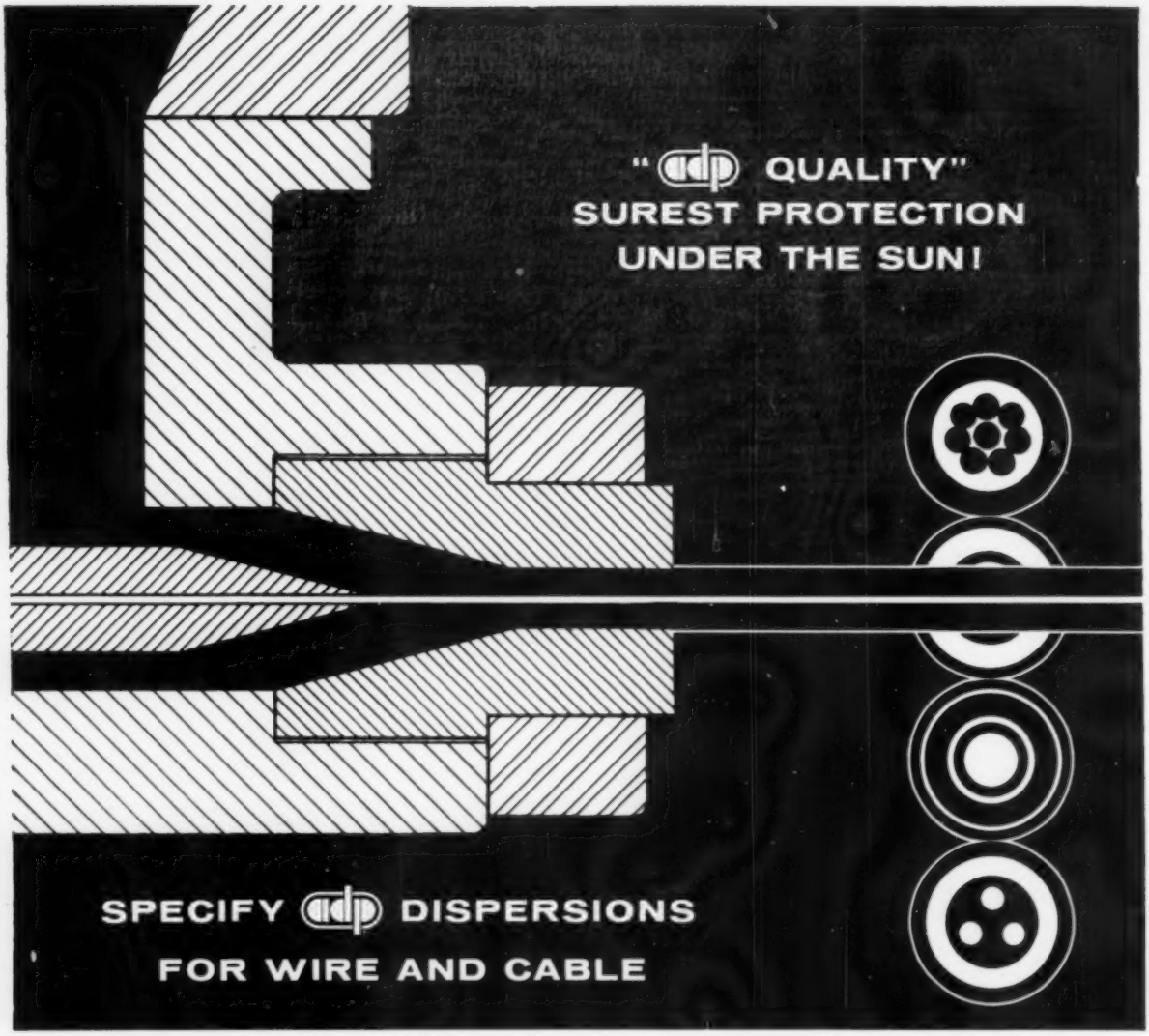

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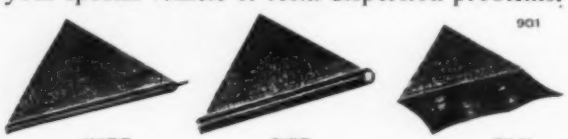

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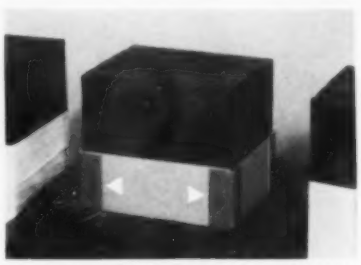

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This Month in Brief

The lead article this month discusses "Improved Techniques for Extrusion of Teflon 100 FEP-Fluorocarbon Resin. It describes how to attain extrusion speeds up to 1,300 feet per minute - over twice the maximum speeds previously obtained.

"Long-Term Durability of Polyesters in Glass-Reinforced Parts" is based on five-year exposures of glass-reinforced acrylic and polyester-acrylic panels. The latter type was found superior to straight acrylic because of better resistance to moisture and stress-crazing.

"A New Weathering Stabilizer for Poly(vinyl chloride)" is hexamethylphosphoric triamide (HTP) which produces excellent results provided care is taken in formulation to retain heat stability.

"Rockwell Hardness Scale Comparison" represents an effort to get a true comparison of figures obtained by Rockwell R, L, and M scales.

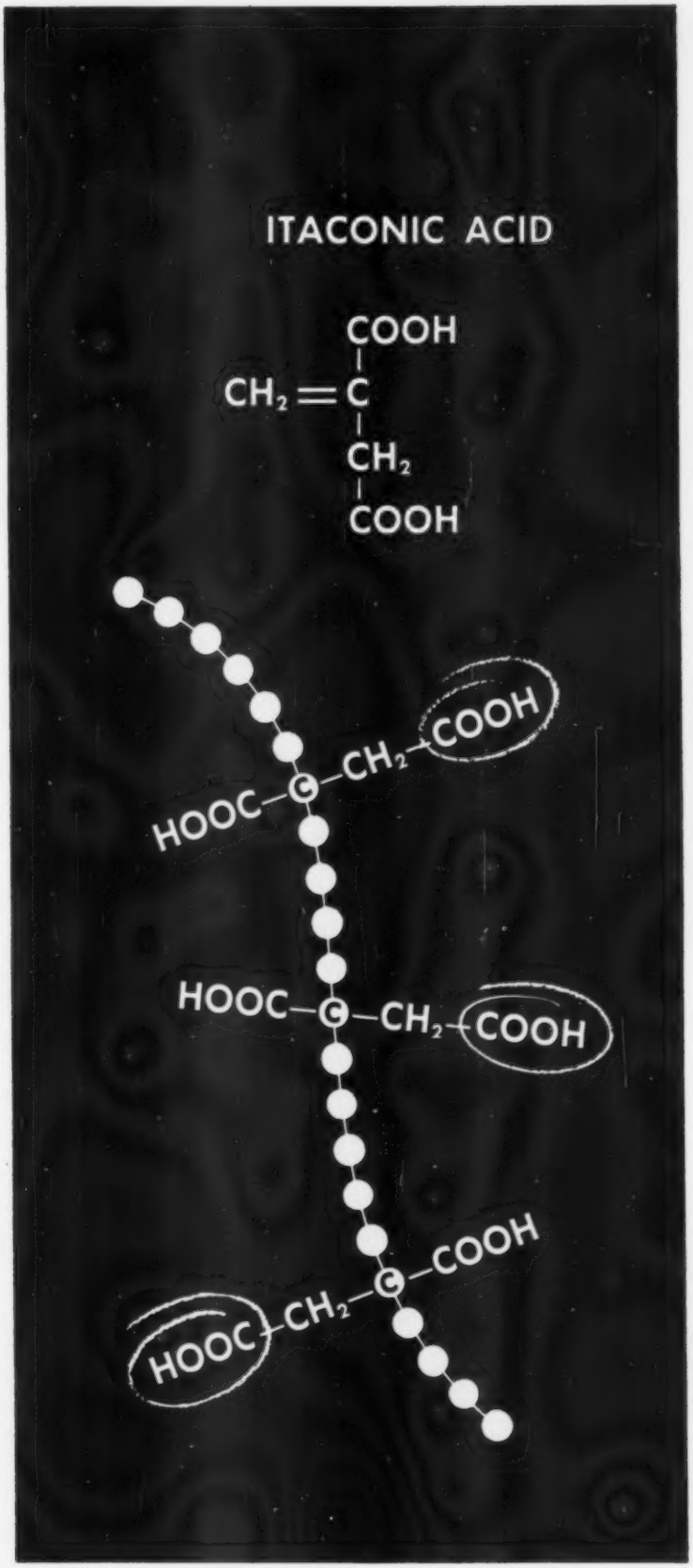
Realignment of editorial staff functions is discussed in the Editorial this month. Editor Art Merrill moves up to Editorial Director, with responsibility for long-range plans, special features, and a newly-created book department. Managing editor Jim Dugan takes over the position of Editor, and will direct month-to-month operations.

This month's Guest Editorial, by D. E. Scott covers the subject of industrial design as it affects plastics. He points out the pitfalls to be encountered by the plastics producers, where improper material selection and bad design can set back consumer acceptance by years and cost untold millions of dollars to correct errors in judgment.

The Consultant's Column by Dr. S. S. Stivala is concerned with adhesives. Three questions are answered: What is the proper surface treatment of materials to be adhered by epoxies? What adhesive best bonds butyrate to magnesium? How to bond polyethylene to itself?

Exploring Fabrication Techniques describes an Eastman die for film extrusion. The die contains a channel which carries the plastic from the extruder barrel to the center of the die's manifold.

Three features this month: Freight car door linings - expanded polystyrene within an ABS shell. A full-scale model heart, all parts molded of polystyrene. Reinforced plastics in the construction industry - especially lighting panels.



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Joe Foster, President, discusses Foster Grant's pioneer experience with bulk handling polystyrene.

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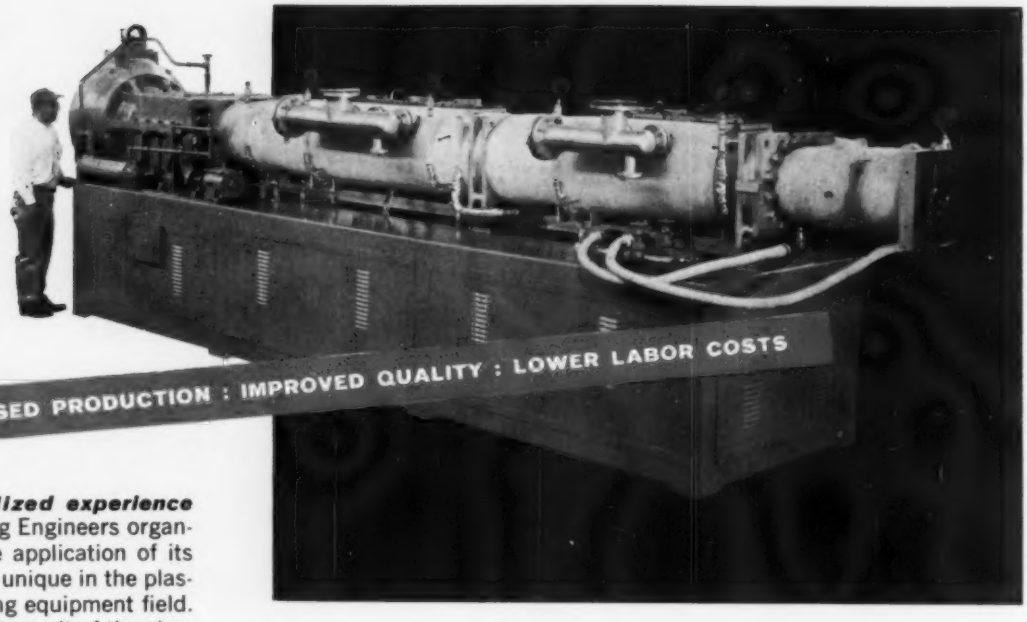

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

How to extrude the resin at speeds previously impossible for the original Teflon resin.

Improved techniques for extrusion of "Teflon" 100 FEP-Fluorocarbon resin

J. A. BLAIR*
H. J. HAON III*

Because of its excellent electrical, mechanical, thermal, and chemical resistant properties, Du Pont's "Teflon" 100 FEP-fluorocarbon resin is a natural for use in insulating electrical wires and cables. Many different constructions using "Teflon" 100 have been produced, illustrating the remarkable versatility of this resin as an insulating and jacketing material at continuous service temperatures as high as 200° C. However, because of its higher-than-average melt viscosity and low thermal conductivity, certain fabrication limitations have been encountered.

Production rates for smooth-surfaced wire coatings have been limited. It has been difficult to produce primary insulations less than five mils thick in continuous lengths free from dielectric flaws. Fabrication of tight, round coatings (more than 50 mils thick) on small-diameter wire has been difficult. However, recent work carried out at the Technical Services Laboratory of Du Pont's Polychemicals Department has improved extrusion techniques to a point that these limitations soon may be overcome.

Extrusion Rates

Extrusion rates using "Teflon" 100 FEP resin previously had been limited to 300-600 feet per minute, depending on wire or cable diameter and coating thickness. At faster rates, the coatings become rough. This roughness is caused by excessive shearing of the resin as it flows through the extrusion die, and is commonly called "melt fracture". The effects of melt fracture are characteristic of all thermoplastics. However, these effects increase with the viscosity of the resin and, since molten "Teflon" 100 has a viscosity higher than average, melt fracture occurs more readily.

Two steps may be taken to reduce or eliminate surface roughness due to melt fracture: (1). Increase the die opening, and (2). Lower the resin viscosity by keeping the resin as hot as possible.

Die Design

Tubing-type dies having large annular openings are used for extrusion of "Teflon" 100 resin because they result in less shearing of the resin than do pressure-type dies. With a tubing-type die, the resin extrudes from the die as a tube and, while still molten, is drawn down on the wire or cable being coated (see Figure 1).

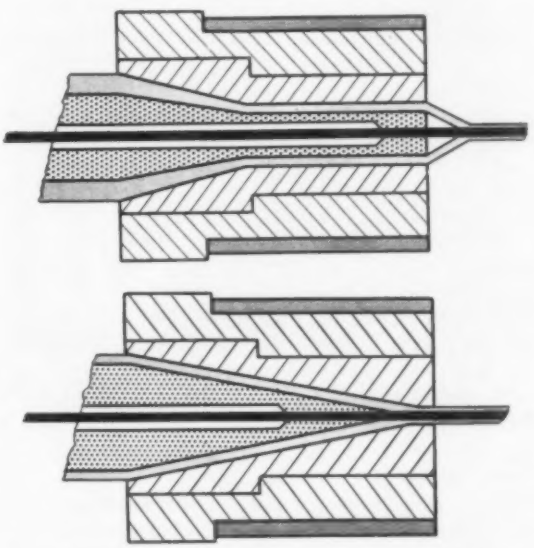


Fig. 1. Cross-sectional drawings of recommended extrusion dies for Teflon 100: (upper) tubing type die; and (lower) pressure type die.

* Sales Technologists, Polychemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del.

As the annular opening of a tubing-die is increased, less resin shearing occurs. Therefore, with "Teflon" 100 the larger the die opening, the faster the resin can be extruded without surface roughness due to melt fracture.

Resin & Die Temperatures

The other way to reduce shearing is to lower the viscosity of the resin by raising its temperature. This is achieved by setting high temperatures on the extruder barrel and crosshead body. To maintain a high resin temperature as it passes through the die, it is extremely important to provide a separately-controlled heater on the die itself (as shown in Figure 2). An important element of the crosshead design of Figure 2 is the metal-to-metal contact between the die, die holder, and die heater which permits uniform heating of the die to the desired high temperature. As with all thermoplastics, care must be taken not to degrade the "Teflon" 100 FEP resin when extruding at very high temperatures.

Reducing Orientation

Using a heated, large-opening die (0.65-inch I.D., 0.30-inch O.D. guider tip) and the highest possible resin temperature short of degradation, stranded #22 gauge conductor was coated with 10 mils of "Teflon" 100. The heated die permitted wire speeds of 800 feet per minute, or approximately 25% faster than in the past.

However, at wire speeds greater than 800 feet per minute, the coating developed excessive strains (coating shrank one inch when cut), and small surface cracks and pinholes resulting in frequent dielectric failures in a spark test. Also, the cone of resin being drawn from the die down onto the wire broke frequently. These faults were found to be caused by excessive orientation of the resin during the draw-down operation.

This orientation was reduced by installing three three-foot radiant heaters at the die outlet (see Figure 3). The heaters reduced the heat loss from the molten resin during draw-down, thus preventing the initiation of cracks, pinholes, or cone breaks. Also, the distance between the die and the point of initial contact for the resin and conductor (cone length) was allowed to be about six inches, rather than the usual 1-2 inches. Greater cone length reduced the rate of draw-down, thus minimizing orientation.

Using the radiant heaters and the long cone, wire speeds of 1,300 feet per minute have been obtained. The properties of wire made at this rate are shown in Table 1. An occasional spark test flaw did occur at rates of 1,300 feet per minute. However, it appears that improved design of the radiant heaters may eliminate even these infrequent flaws. The heaters used were rated at 1,100 watts each.

Thin Coatings

Although coatings of "Teflon" FEP resin less than five mils thick occasionally have been applied as jacketing over conductors greater than $\frac{1}{16}$-inch in diameter, it has been extremely difficult to extrude continuous lengths of flaw-free primary insulations on fine wire sizes. As the coating thickness is reduced below five mils, the coating begins to develop surface cracks, and the extrusion is hampered by resin cone breaks. Using the radiant heaters at the outlet of the die, it was possible to produce three-mil coatings in long lengths without cone breaks, and with only an occasional dielectric flaw. Again, improved design of the radiant heaters may offer complete elimination of these flaws, and may make possible even thinner coatings.

John A. Blair is a native of Birmingham, Ala., and a 1951 graduate of Auburn University. A chemical engineer, he is 32 years old and has spent his entire work career with E. I. du Pont de Nemours & Co. Mr. Blair joined the explosives department upon graduation, moving on to the AEC plant at Oak Ridge and the Savannah River plant as senior supervisor. In 1959, he transferred to Wilmington where he is currently a sales technologist, poly-chemicals department.

Harry J. Haon III was born in London, England, on August 2, 1934. He was graduated from Princeton University with a BSE (Basic Engineering) in 1956. Mr. Haon joined the polychemicals department of DuPont in 1957 as a sales technologist, his current position.

Thick Coatings

Coatings of "Teflon" 100 FEP resin greater than 30 mils in thickness have been applied successfully to conductors larger than #18 gauge. With smaller conductors, however, these thick coatings usually have been quite loose.

When a wire coated with a thermoplastic is cooled rapidly from the melt state, a solidified skin of resin is quickly formed on the outside of the insulation. Due to the low thermal conductivity of "Teflon" 100, the material under this skin remains molten until subsequent

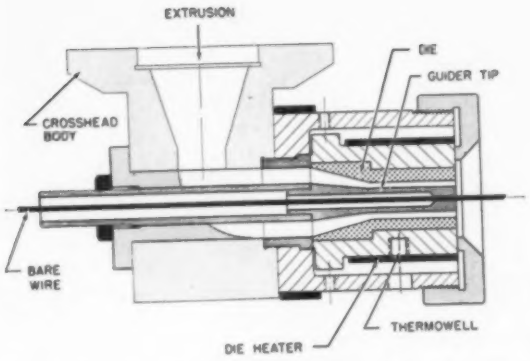


Fig. 2. Cross-sectional drawing of Teflon extrusion through a heated die.

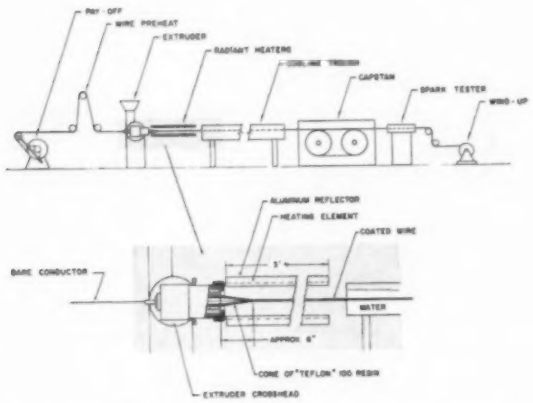


Fig. 3. Extrusion of Teflon 100 wire coating with radiant heaters.

Table I. Properties of 10-Mil Coating of "Teflon" 100 Resin on Stranded #22 Wire.

Dielectric Strength, volts/mil	1,200-1,400
Insulation Resistance, megohms/1,000 feet	8×10^7
Surface Resistance, megohms	>1,000
Dielectric Constant, 10^6 cps	<2.1
Dissipation Factor, 10^6 cps.	0.0004
Soak Test: four hrs. in water plus dispersing agent	Passed 2.2 KV. for one minute.
Cold Bend: four hrs. at —65° C.	Passed 2.2 KV. for one minute. Showed no cracking on ¼-inch mandrel wrap.
Heat Aging: 96 hrs. at 250° C.	Passed 2.2 KV. for one minute. Showed no cracking on 0.150-inch mandrel wrap.

cooling takes place. As the molten material under the outer skin cools, it undergoes considerable shrinkage and, being confined by the solidified outer shell, shrinks away from the conductor. This looseness can be avoided by slow cooling of the coating.

Slow cooling is achieved by proper balance of the extrusion rate and the length of air-cooling before water quench for coatings of "Teflon" 100. By using an air gap of 20 feet between the die and point of water cooling, in combination with a wire speed of 30 feet per minute, tight, round coatings of "Teflon" 100 as thick as 100 mils were obtained on small-diameter conductors. The length of time the coating was subjected to this air cooling was approximately 40 seconds. By increasing the air gap beyond 20 feet, it would appear possible to increase the wire speed while still maintaining the 40 seconds of air cooling necessary for tightness.

—THE END

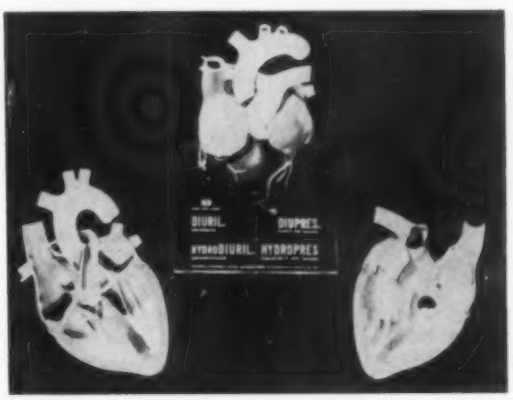
Model heart aids doctors

Merck and Co., Inc., is distributing a plastic heart in natural color and complete scale detail to members of the medical profession in the United States and abroad. The model, actually the size of the heart in an 18-year old adult, was engineered and produced by Nosco Plastics, Inc., Erie, Pa.

The model is so constructed that it can be taken apart in two pieces to disclose the interior. Thus, doctors can use it for describing and explaining heart conditions to their patients.

In order to accurately reproduce the human heart, Nosco molded it in 21 pieces. It is probably one of the most complex molded plastic products, since almost every section has compound curved parting lines which must fit together perfectly for proper cementing.

Since the heart was to be true to detail in color as well as size and shape, 29 spray painting operations in nine colors were necessary. Twenty-six masks were designed for the spray painting. The final assembly requires 25 cementing operations.



Model heart, molded by Nosco Plastics, Inc. for Merck and Co., Inc., divides in the middle for demonstration purposes.

The heart is molded in three cavity injection molding machines from high impact-resistant polystyrene. The stand, which carries advertising for Merck, is formed from general purpose polystyrene in a separate mold.

Rockwell hardness scale comparison

A ready-reference chart for quick comparison of three hardness scales.

CHARLES ANDREWS*

In the custom molding business where a company uses a tremendous amount of various materials, or of the same material but with varying degrees of hardness, a scale or comparison chart is required. Customers and sales personnel will then be more adept in correlating the hardnesses of various types of materials to other materials which cannot always be tested on the same or closely-relevant scales. An attempt has been made to get a true comparison of figures between the Rockwell "R," "L," and "M" scales which are the most frequently-used by Chicago Molded Products in their classification of materials.

Test Program

To start the project properly, V. E. Lysaght, Sales Manager for the Wilson Mechanical Instrument Division, American Chain & Cable Co., Inc., makers of the Rockwell Hardness Tester, was contacted for assistance and information. The ball penetrators for the project were supplied by Mr. Lysaght to the Chicago Molded Products Laboratory. After an interchange of correspondence, M. Lysaght pointed out the basic concept of the Rockwell test; that is, the test is arbitrary and not related to fundamental properties. The machine is used to obtain comparison data, and difficulties might arise in actually correlating the hardnesses between various materials on the different Rockwell scales. This problem was mentioned in his letter, as follows:

"Indentation hardness is not a fundamental property of a material but is dependent on several fundamental properties. Thus, the term 'indentation hardness' has no quantitative meaning except in terms of a particular test in which the size and shape of the indenter, the indenting load, and other conditions of the test are specified. As an illustration of this fact; a series of specimens might be selected and graded to fall at uniform intervals throughout some particular hardness scale, but they would not necessarily have the same values, and would not of necessity be of uniform intervals on the same of the second test."

Understanding these problems, a series of programs was outlined that would closely follow the ASTM test method in D785-51. This test covers the scales which we were attempting to correlate, and which are widely used by the entire plastics industry. After gaining a basic understanding of the functions and necessities of this test, it was decided to approach the problem is one of three ways:

(1). By using the ASTM test as to weight for each Rockwell test but, however, to change the time factors from 15 seconds to as much as 30 seconds and see if a large overlap of readings could be obtained.

(2). To actually change the weight readings for each test, and again see if a substantial overlap could be obtained.

(3). To take the readings as specifically outlined in D785-51 and attempt to get different scale readings on the various materials and then correlate or tabulate all these results.

After looking carefully into the problem, and after a certain amount of preliminary testing, it was found that by changing the time factors on various materials, no large amount of change was noticed. We did not feel that this change was large enough or was much greater than the normal amount of variation between laboratories on making one specific type of Rockwell reading on one specific material, and using one specific scale. Therefore, this method was dropped, and was not used as an avenue of approach.

On attempting to change the weights, when investigating the information received from Wilson, we realized that we would merely derive other scales which are outlined in Table 1 to make this point more easily understood.

Since all we would be doing would be receiving information on different scales, and not gaining the information which was the original purpose of the project, this method also was discarded.

* Laboratory Manager, Chicago Molded Products Corp., Chicago, Ill.

The last method offered the best approach; i.e., to record different scale readings at the bottom, top, and medium ranges for various types of materials. A group of 16 materials was lined up for their general differences in hardnesses, and each material was run through the "R," "L," and "M" scales. All these tests were made on the Rockwell normal-type tester that has a scale reading of 150 units. Each reading was taken at least six times, or until an average of ± 3 points was reached for each one of the materials (see Table 2). All materials were run on days where the relative humidity and temperature were approximately the same, but no tests were run in an absolutely-controlled atmosphere. Since the results came out with a very close variation, it was decided that the information gathered was reliable enough to proceed with figuring the variants between the "R," "L," and "M" scales and how they looked on a graph.

Rockwell hardness numbers were used, running from 140 down through —30, to give a good coverage on the ordinant of the graph. The abscissa was not as simple, since each material tested could not be assigned a specific point in numerical order. It was felt that an arbitrary scale was the best reference method. In other words, for every point on the ordinant, a point would be picked on the abscissa that would be a specific ratio of an ordinant. In this way, the graphs could be drawn to present the data in the easiest possible manner. To make sure that the graph would be complete and offer the most information, it was necessary to make three graphs.

Test Results

The first graph (Figure 1), we call the "R"-scale graph wherein the readings for the "R" scale were plotted in a straight line. The points on the "R" scale for each material were marked off on the abscissa and then cross-referenced to the ordinant where points were marked off for the "L" and "M" scales, and the graph drawn. This scale seemed fairly comprehensive, except that it looked quite jagged.

Therefore, it was decided to draw an "M"-scale graph (see Figure 2). Since minus values on the "M"-scale readings indicated a plateau, it was assumed that the penetrator was sinking too far into the material to be valid. Accordingly, these figures were omitted from all the graphs. In Figure 2, the same approach was used with the same scaling; however, again the results were not satisfactorily accepted. An "L"-scale graph (Figure 3) was then drawn and with the intention of trying to straighten out the "M" curve, a different scale was tried and that was at 1:1.5. This graph seemed to be the best; however, it was decided to change the scale for the final graph to attempt to straighten the curves out even more.

In drawing up the final graph (Figure 4), a scale of 1:1 was used, and the graph opened up. On this graph, as mentioned before, the "L" scale was plotted straight, while the "M" and "R" scales were plotted with reference to the "L" curve by the method explained earlier. In drawing the graphs, it was noted that the three scales tended to approach each other at

Table 1. Rockwell Hardness Scales

Scale Symbol	Ball Penetrator, In.	Load, Kilograms	Dial Figures
E	1/8	60	Red
L	1/4	60	Red
M	1/4	100	Red
P	1/4	150	Red
R	1/2	60	Red
S	1/2	100	Red
V	1/2	150	Red

Table 2. Hardness Test Results

Number of Materials	Scales "R"	"L"	"M"
1	128	118	116
2	124	114	107
3	123	107	89
4	110	84	64
5	109	78	24
6	106	68	23
7	90	26	— 19
8	88	27	— 20
9	86	22	— 30
10	85	15	— 23
11	84	11	— 35
12	78	0	— 6
13	67	— 5	— 25
14	66	— 15	— 24
15	59	— 20	— 22
16	15	— 28	— 29

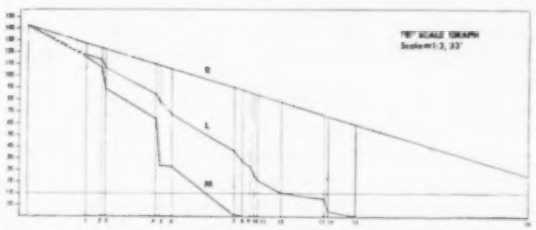


Fig. 1. Hardness points on "R", "L", and "M" scales for test materials on an "R" scale graph (1:3).

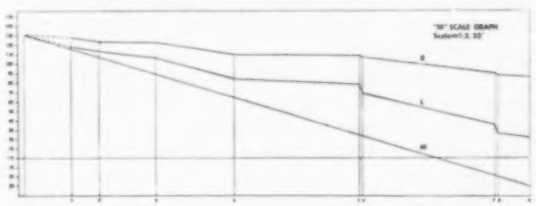


Fig. 2. Hardness points on "R", "L", and "M" scales for test materials on an "M" scale graph (1:3).

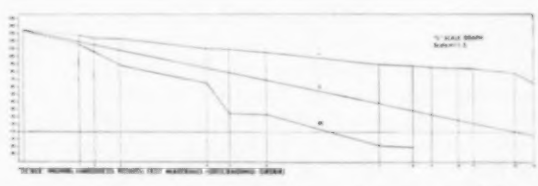


Fig. 3. Hardness points on "R", "L", and "M" scales for test materials on an "L" scale graph (1:1).

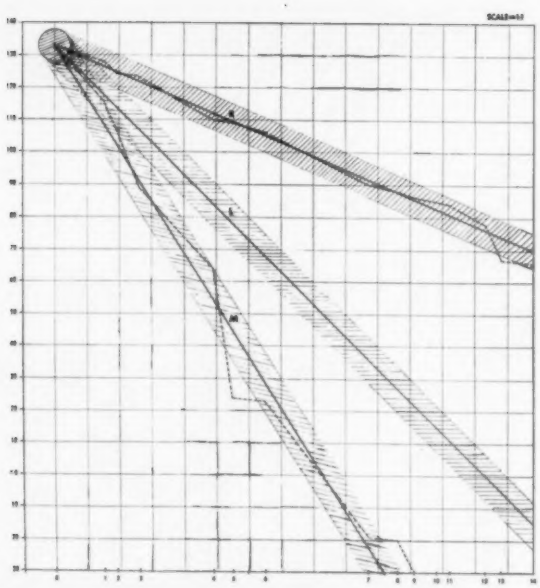


Fig. 4. Comparison of Rockwell "R", "L", and "M" hardness scales with shaded areas showing ±5 points in measurement.

a point, and it was decided to continue the tests up into aluminum and steel, using the ASTM method. To make the graph appear more reasonable, a sweep line of ± 5 points in measurement, which we felt was about average for most testing laboratories, was put in on the graph in a shaded area. These shaded areas came together and formed a circle around the junction point.

It should be noted that the ± 5 points apply only at the meeting point of the three curves, and present a different amount of variations on each specific curve. The values from the scale were checked with various other materials such as Rohm and Haas' figures for Implex which are given in three values, and it was found that the chart was close enough so that it would be of assistance in cross-indexing the hardness of one material to another. The next step then was to analyze the graph and decide on important factors in using the Rockwell Tester.

One thing that was noted was a large deviation on the "M" scale, starting at around 65, and its erratic behavior on down from that point. Also, since the shaded area of "M" and the shaded area of "L" cross at about 100, we felt the scale's limitations on "M" possibly would run between 65 and 105. To check this out, we looked at a Chart of Materials and noticed that all "M"-scale readings run between 65 and 105 for plastics testing. Whether this is coincidental or not is yet to be seen. On the shaded area between the "L" and "R" scales, it is noted that they do not cross until they reach a point of around 118. Putting this fact together with the fact that the "R" scale becomes rather erratic around 80, it might be advisable to assume that this would be a point where one would switch over from "L" to "R," or vice-versa.

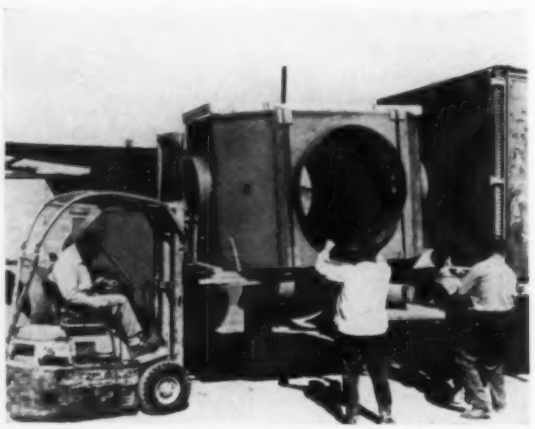
The common range between 80 and 110 possibly means that either the "R" or the "L" scale would prove satisfactory in this range. On plastics, it seems that the "M" scale has a very short area for testing, and that the "L" scale probably is preferable for running tests that are more reliable. It is possible that these graphs can be extended away from the direction of their point of connection. However, in the normal range of testing plastics, the laboratory had no tes. figures in this area and felt that the present graph would prove satisfactory in giving the information needed.

The conclusion of this test seems to bear up the fact that each one of these scales is an individual scale by itself. Each of these scales arcs off in a different inclination to give a specific area of reading to a plastic. These areas have a common starting ground, but this common starting ground is not accurate until you reach the point where the "M," "L," and "R" scales do not overlap each other and become individual scales by themselves. This is borne out by the fact that ASTM recommends that any scale reading over 115, should be definitely dropped to the next scale wherein it gets down into an area that is apt to be more accurate and reliable. Again, this is evident on the "M" scale, where the limitations of accuracy are even less.

Conclusions

We feel that the data derived from the tests and scales prove to be very beneficial to our operations when comparing different plastics. However, we are not assuming that these values are developed to such a point that a specific hardness on one material can be guaranteed to be another hardness in another material. Each test is comparative in its own right and a certain amount of operator efficiency between laboratories also will change the other factors of accuracy. We do feel, however, that we have a chart which can be used as a ready reference between the various "R", "L," and "M" scales of hardness for plastics, so that engineers have an easier method of deciding on and designing plastics of various types into their products.

—THE END



Jumbo junction box fabricated of glass-reinforced Hetron polyester resin by du Verre, Inc., Arcade, N. Y. Part is designed for ventilating system of a metalworking plant.

A new weathering stabilizer for poly (vinyl chloride) plastic

Hexamethylphosphoric triamide (HPT) is effective when properly formulated.

H. W. COOVER, JR.,* R. L. McCONNELL,**
G. C. NEWLAND,# J. W. TAMBLYN*

Poly(vinyl chloride), or PVC, is an excellent low-cost plastic for outdoor uses where the properties of toughness and durability are important. Railway cables, covered with properly pigmented vinyl compositions, are reported to be still good after 10 years' use in Germany (1).***

Even unstabilized PVC can remain serviceable for a remarkably long time outdoors, although a dark brown to black discoloration develops during the first few months of exposure. Geon 101##, plasticized with 30 parts by weight of dioctylphthalate (bis(2-ethylhexyl) phthalate) and molded in the form of a 0.1-inch thick sheet, for example, was still tough and strong after seven years' exposure on a roof, inclined at 36° to the horizontal, in Kingsport, Tennessee. No break occurred in this sample when it was subjected to a 90° bend in the Tour-Marshall test for stiffness in flexure (2); the exposed side being on the outside of the bend.

The stiffness of this sample had increased by 50% over its original value, and 70% of this increase occurred during the first two summer months of exposure. Cracks slowly formed in the exposed surface, becoming visible to the eye before the end of the first summer, and increasing to a depth of 5-10 mils by the end of seven years. Discoloration occurred very rapidly, progressing from an initial transparent brown to a dark brown by the end of the first summer, and finally to an opaque black in two years. Failure of PVC articles exposed to sunlight usually is due to discoloration, rather than to loss of toughness.

The discoloration of PVC by heat or light is probably caused by the autocatalytic release of hydrogen chloride, with the formation and oxidation of conjugated polyene systems (3,4,5,6).

Rather detailed mechanisms for the degradation of PVC involving free-radical chain reactions have been proposed recently by Winkler (7) and Fuchsman (8). Certainly, free radicals have been detected by electron paramagnetic resonance absorption in PVC which has been exposed to ultraviolet light (9).

Test Program

The purpose of the work described here was to find formulations of PVC which would have improved weatherability and, at the same time, a reasonable degree of heat stability. Various stabilizers were added to the basic, unstabilized control formulation described earlier. This control formulation will be designated Composition A. Table 1 lists the compositions studied.

Many of the stabilizers customarily used in PVC are primarily hydrogen chloride absorbers; for example, sodium carbonate, basic lead salts, long-chain fatty acid salts of alkaline earth and other metals, epoxy compounds, and organotin derivatives. In actual practice, acid absorbers by themselves are not highly effective weathering stabilizers for PVC. Dibutyltin dilaurate is a good example; when four parts by weight of this stabilizer were roll-compounded with the ingredients of Composition A to give Composition B and compression-molded into colorless sheets, a brown discoloration began after two years of outdoor exposure and then very quickly darkened almost to black before the end of the third year. By this time, the surface cracks had become fully as deep as those of Composition A. The net benefit obtained from the use of this stabilizer, thus, was merely an additional 1½ years of freedom from discoloration.

A PVC formulation recommended for outdoor stability at the time these exposures were started also was compounded and exposed. It was labeled Composition C. This formulation was compounded without discoloration, but developed brown spots in one year, becoming dark brown in 2½ years and black in 3½ years. Surface cracks developed in 3 years.

* Research associate.
** Sr. research chemist.
# Research chemist, all of Research Labs., Tennessee Eastman Co., Div of Eastman Kodak Co., Kingsport, Tenn.

*** Numbers in parentheses refer to Bibliography at end of article.
A product of B. F. Goodrich Chemical Co., Cleveland, O.

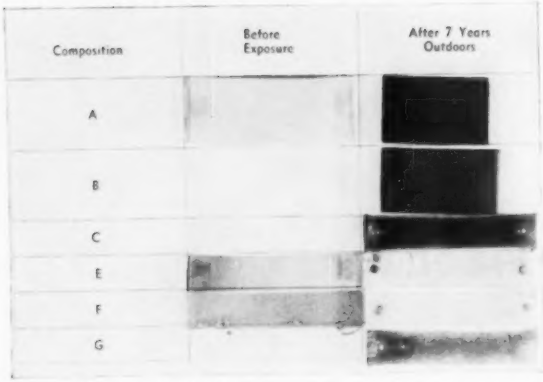


Fig. 1. Poly(vinyl chloride) compositions after seven years' exposure.

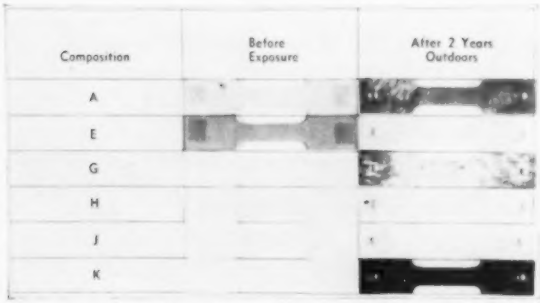


Fig. 2. Poly(vinyl chloride) compositions after two years' exposure.

Recently, various derivatives of 2-hydroxybenzophenone have come into general use as ultraviolet stabilizers for plastics. Like the organotin derivatives, however, these compounds, by themselves, are not satisfactory as stabilizers for PVC. Composition D developed surface cracks during the first year of outdoor exposure. Considerably more brown color formed in Composition D during compounding than in Composition A. This initial heat-developed color showed no sign of fading during the outdoor exposure. Such fading often has been observed in PVC which has been compounded with an additive which is a good light stabilizer, but a poor heat stabilizer. It has been reported recently that PVC compositions of excellent weatherability can be prepared by use of the benzophenone light stabilizers, if proper attention is paid to formulation (10, 11, 12).

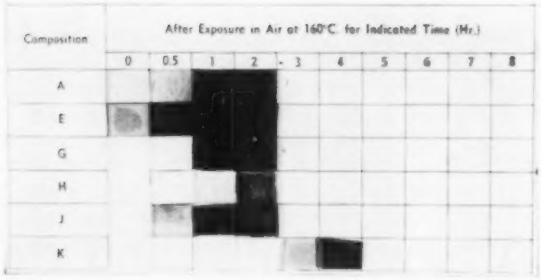


Fig. 3. Heat stability of poly(vinyl chloride) Compositions A through K.

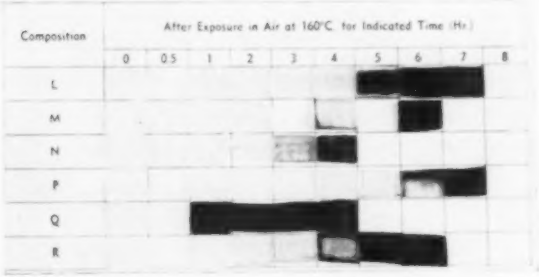


Fig. 4. Heat stability of poly(vinyl chloride) Compositions L through R.

The best single additive for PVC we have found for preventing discoloration and surface cracking by ultraviolet light is hexamethylphosphoric triamide (HPT) (13). The incorporation of HPT increased the color of the plastic during the compounding of Composition E, as in the case of the benzophenones. On exposure to sunlight, however, this color disappeared rapidly, and no appreciable color yet has reappeared after seven years outdoors, except for a few small yellow-brown spots which began to show up during the seventh year. Some internal haze formed gradually during the outdoor exposure, but no surface cracks developed. This is a remarkable performance for a PVC stabilizer.

In an attempt to avoid the discoloration obtained during compounding with hexamethylphosphoric triamide, compositions containing two different heat stabilizers were tested (Composition F and Composition G). Composition F gave almost as much discoloration during compounding as Composition E, but bleached just as rapidly on exposure outdoors, and is in even better condition than Composition E after seven years

R. L. McConnell

H. W. Coover, Jr.

J. W. Tamblyn

G. C. Newland

Table I. Rockwell Hardness Scales

	Compositions, Parts by Weight															
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
Geon 101	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Dioctyl phthalate	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Dibutyltin dilaurate		4														
Dibutyltin maleate			1													
Stabilizer S-3#			0.5													
Calcium stearate			0.3													
Carnauba wax			1													
2,2'-Dihydroxy-4,4'-dimethoxybenzophenone				4												
HPT (hexamethylphosphoric triamide)					2.5	2	2	2	2	2	2	2	2	2		
Sodium carbonate						2										
Staflex OY*							2			2						1
Ferro 900**							2			2						
Dibutyltin diacetate								2								
Flomax 25##									2							
Stabilizer 17-M#																1
Epon 812###											2	1	1	1		
Diepoxide AG-13E###													1			
Stabilizer 201####														1		
Ferro 1820**															2	
Triphenyl phosphite															1	
2,2'-Dihydroxy-4-methoxybenzophenone															0.2	
Paraplex G-62###																3
Mark PL####																1
2-Hydroxy-4-methoxybenzophenone																2

Made by Advance Solvents and Chemical Corp., New Brunswick, N. J. Stabilizer S-3 is a polymeric tin stabilizer; Stabilizer 17-M is an organotin-sulfur compound.
* Fatty acid salts from Deecy Products Co., Cambridge, Mass.
** Made by Ferro Chemical Corp., Bedford, O. Staflex OY is an epoxy compound; Ferro 1820 is a barium-cadmium laurate.
Made by National Lead Co., New York, N. Y.
An epoxy compound made by Shell Chemical Corp., New York, N. Y.
Made by Rohm & Haas Co., Philadelphia, Pa. Paraplex G-62 is an epoxidized oil.
An organozinc compound from Argus Chemical Corp., Brooklyn, N. Y.

exposure, showing no colored spots or cracks. However, it did show the formation of internal haze. Composition G was clear and colorless after compounding, and remained in this condition for almost two years. At the end of that time, it showed a slight brownish color which increased gradually to brown after seven years. Surface cracking appeared after four years.

Test Results

The appearance of Compositions A, B, C, E, F, and G both before and after seven years' outdoor exposure is shown in Figure 1. The problem, therefore, is seen to be one of obtaining a more satisfactory compromise between light and heat (or processing) stability.

Several heat stabilizers already have been found which can be combined with HPT to give compoundings as free from color as Composition G, and which exceed the latter in weathering stability. For examples, see Composition H and Composition J.

It remains to be seen whether Compositions H and J will equal or exceed Compositions E and F in weathering stability. In one respect—absence of internal haze formation after two years outdoors—they already have shown superiority. Figure 2 shows their appearance both before and after two years' exposure, along with similar samples of Compositions A, E, and G. A sixth formulation, Composition K, also was included for comparison, especially with Composition G. The heat stabilizers alone gave no worthwhile protection against weathering. Although Composition K remained lighter in color than Composition A during the first few months of exposure, K had become darker than A by the end of the first year's exposure.

Compositions containing HPT and having still better heat stability than Compositions G, H, J, or even K, have been prepared; for example, Composition L, Composition M, Composition N, and Composition P.

The resistance of these formulations to discoloration in air at 160° C. is shown in Figures 3 and 4. Compositions A, E, G, H, J, and K are included for comparison. Also included are two additional formulations

(Continued on page 56)

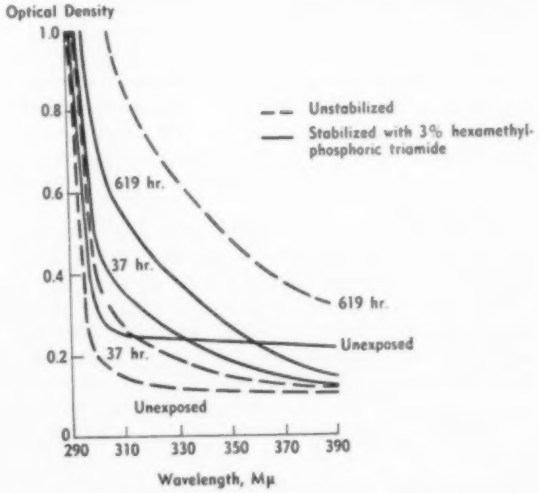


Fig. 5. Effect of sun-lamp exposure on the ultraviolet absorption of stabilized and unstabilized poly(vinyl chloride) films.

Guest Editorial

Industrial design and the battle for material supremacy

D. E. SCOTT*

Today, consumer-goods manufacturers are engaged in a tug-of-war, and their ranks are being swelled by legions of consumers who are joining them in demanding to know which specific materials are best for given products.

The boating enthusiast, for example, wants to know what kind of boat will best suit his needs. Aluminum offers strength and lightness; it needs no painting. Plastic, reinforced with glass fiber, provides beauty, durability, and design detail. A synthetic rubber-plastic blend will take a lot of punishment where impact resistance is a factor. If the would-be sailor is not confused by what appears to be three sets of conflicting claims, he will be when he consults the traditional seaman who will tell him that wood is best.

The situation is not peculiar to the boat manufacturing business. Basic materials marketing is extremely competitive today. A fierce contest exists among producers of rival materials in nearly every major industrial line. Conflicting claims are advanced for each of these materials, and expensive campaigns have been launched to market them.

Pressing the battle are the producers of relatively new materials whose very existence depends on wresting at least a portion of the market from makers of traditional materials. In their headlong haste to get these new compounds into mass production (and into the hands of the consumer), some of these producers have made serious blunders. In the case of plastics, errors in judgment are taking years of effort and millions of dollars in advertising and public-relations campaigns to correct.

For example, take the problem encountered by the owner of a new, high-powered, vista-domed car. It looks wonderful when you view it in an air-conditioned showroom. But driving that car in the hot sun of the Arizona desert is quite another matter! These misfortunes, resulting from the misapplication of materials, can happen in almost any industry.

Such misuse has made extremely difficult the job of gaining acceptance for new materials. And such acceptance must be gotten from the manufacturer, and even more important, from the consumer.

Early misapplications of plastic materials established in consumers' minds the impression that "plastic" is virtually synonymous with "cheap". For years, no plastic was considered acceptable for products of any great worth. Thanks, however, to the tremendous advances made in the technology of plastics, and to the superb job done in re-educating the converters, the improper use of these materials is far less common today.

At a recent meeting on product design and development in the engineering department of a major manufacturer, the discussion centered on the material specified for a certain part, then in the pilot-run stage. This part, made of a particular plastic, had been underdesigned structurally. It was flimsy. The fault was with the design, not the material. The choice of plastic was sound. Yet, one of the executives in charge of the program demanded that the material for the part be changed to a metal die casting. This was necessary, he said, because the part had to "look and feel like quality!"

As the industrial-design consultants in attendance at the meeting, we were able to convince the executive that the material selection was correct. We showed him that, by re-designing certain areas, the part in question actually could be made superior to the proposed die casting—and at far less cost.

* Staff Designer, Sundberg-Ferrar, Inc., Detroit, Mich.

We are faced today with an array of marvelous new materials, each of which has its own distinct characteristics, and each of which will do certain jobs well. Unfortunately, there are innumerable examples of the missapplication of these materials. The problem exists, and we must solve it as soon as possible.

The approach to the solution is two-pronged:

(1). We must find ways to get into the hands of the manufacturers accurate, up-to-date information on each material and its characteristics. Then, and only then, will choices of materials be based on sound engineering principles, rather than on producers' selling propositions.

(2). We must find more effective ways of getting the same kind of information into the hands of the consumer—who, after all, has an important decision to make in the market place. Obviously the information for the consumer must go through the hands of the skilled communication specialist, who can provide the necessary translation into the language of the layman.

The industrial designer can perform a vital function in the process of informing the manufacturer. He is being called on with increasing frequency to perform this educational service. At Sundberg-Ferrar, we are faced with a material selection problem of some description almost every day.

True, the industrial designer works closely with technicians, engineers, and other authorities who are recongnized for their abilities to select materials for any given product. But the nature of the industrial designer's work puts him in the position of having a definite influence on the materials that are appearing in consumer products.

An important aspect of his relationship with the materials producer is the fact that he makes certain demands for new properties and new developments, to satisfy both present requirements and those that he sees in the future.

The industrial designer assumes the roles of innovator and creator of new forms and concepts. With disciplined imagination, using graphics as a vehicle, he visualizes those concepts and puts them in tangible form.

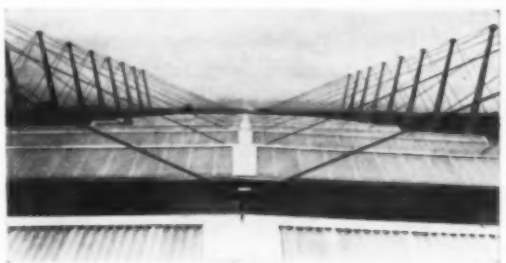
The industrial designer also is a merchandising expert. He keeps his finger on the pulse of the public to determine the nature and appearance of the products the consumers are buying. As a "materials specialist," he plays a leading role in determining the future course of product merchandising.

The plastics industry, in its never-ending quest for newer and better answers to old problems, has opened countless doors of opportunity to the industrial designer. Each year new materials are being added to the imposing list of those that already can do a similar job. The result is a certain amount of confusion in the consumer's mind. In many instances he has little preference so long as the material performs functionally, looks good, is competitively priced, and lasts a reasonable period of time.

The industrial designer works from a detailed evaluation of such factors as price, color, availability, consumer taste, and fabrication method. Because of his ability to weigh all of these factors objectively, he is in a unique position to perform a valuable service in materials selection.

—The End

Plastic panels excite designers



Corrugated Fiberglas-reinforced polyester skylights at Central Washington College of Education, Ellenburg, Wash.

Structural applications of plastics have kept apace with the growth of the construction industry. Laboratory and empirical testing of fiberglass-reinforced translucent panels indicates that their light transmitting and tensile qualities are ideal for interior partitions and exterior curtain walls and skylights.

Seattle architect Ralph Burkhard has designed a building incorporating 45,000 square feet of translucent panelling. Light floods into the health and physical education building at Central Washington College of Education through a series of Everlite and Alsynite skylights and through a translucent band around the building from the top of the walls to the roof. The Fiberglas-reinforced polyester skylights feature double construction with a four-inch air space between the sheets. Since suspension bridge-type steel cables support the roof, no interior pillars are necessary. Electrically operated louvers just below the skylights regulate light and solar heat. In winter, the louvers are closed at night to preserve heat.

Among the distributors of translucent panels and building products is Seaporcel Metals, Inc., of Long Island City, N. Y. The company's Seaporlucent panels consist of two surfaces of fiberglass-reinforced acrylic-polyester panels laminated to extruded aluminum gridwork. Made in a wide range of colors and patterns, the panels can be used for marquees, canopies, partitions, walls, and skylights.

Seaporcel is also distributing Rite-Lite acrylic skylights, fabricated by By-Products Co., Landover, Md. Since acrylic skylights can be made in almost any shape, they are particularly adaptable for unusual skylight problems.

—The End

J. R. Lowry

A. L. Smith

Long-term durabilities of polyesters in glass-reinforced parts

Results of exposures of up to five years demonstrate the superiority of acrylic-polyester over straight-acrylics.

A. L. SMITH* and J. R. LOWRY**

Long term exposure results of up to five years have demonstrated the superiority of acrylic-polyester—Paraplex P-444—over straight 100% acrylics in glass reinforced plastics. Numerous experimental results plus actual installations are offered in substantiation. This apparently anomalous behavior is carefully analyzed and explained.

From the very beginning of the reinforced plastics industry in the early 1940's, outdoor durability has been a characteristic needed for many applications. But outdoor durability was not inherent in the resins first offered. Unsaturated polyesters basically are very stable and durable plastics except in resistance to sun's rays. For the first few years, interest in strength properties dominated consideration for most applications. However, as more and more were used, it was inevitable that reinforced plastics would be used where resistance to outdoor weathering was needed. Early military applications used the resins as they were. If degradation occurred, they were renewed or covered with protective coatings.

It was not until commercial applications in the post war period became more prevalent that the need for improved durability became obvious. In the early 1950's, when installations of some of the first corrugated sheeting in outdoor applications began to discolor and degrade, the full impact of this need for improved durability was felt. It was then that our laboratories made a concerted effort to develop products suitable for durable outdoor use, benefiting from research work dating back to 1947-48.

It was only natural for Rohm & Haas, with its thorough background in developing and promoting plastics for this outdoor durable market, to be early alert to this need and embark on such a program. The intimate knowledge of acrylics dating from 1935, coupled with experience in reinforced plastics since 1944, also made it natural to consider a wedding of the two to give this desired improved durability. The acrylics indeed were dominant and leading candidates in this work.

This intimate knowledge and experience provided the basis for realistic caution and thoroughness in our approach to the problem. Consequently, our program included many experimental formulations with straight-acrylic products designed to investigate cross-linking agents, viscosity controllers, and polymerization controllers to give not only durability, but a reasonably practical product from a processing standpoint. In this work, we drew on our extensive experience in the acrylic sheet and acrylic molding fields.

Early Results

In 1954, after considerable laboratory work and observation of preliminary performance on outdoor exposure, the field of experimental products was narrowed to two: the company's acrylic resin; and P-444 (a com-

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** J. R. Lowry, Staff Member, Devel. & Appls. Lab. for Reinforced Plastics, Rohm & Haas Co., Bristol, Pa.

position of 60 polyester/20 MMA/20 styrene). Augmenting laboratory experiments, actual full-scale installations were made at several plant locations from sheet made on pilot-plant scale. One of these locations had a corrugated Transite addition to the south side of one of our manufacturing buildings. This addition consisted of a sheet of clear corrugated Plexiglas, and three glass-reinforced sheets for admitting light to the area inside. The center consisted of a sheet of Paraplex P-444, flanked by sheets of a 100% acrylic. Close examination of the sheets from inside the building showed the highly-translucent, almost transparent nature of the P-444 sheet, and the fiber prominence and dirt collection that reduced light transmission of the acrylic sheet. This installation now is five years old, and provides very real evidence which we observe continuously. Many laboratory experiments also were a part of this program. Table 1 and Figures 1 and 2 show results of one of these. In this series, comparison was made in clear and five different colors between P-444, R & H acrylic, and P-433 (a conventional light-stabilized, styrene-diluted polyester resin.)

Commercially procured sheets also were included. Degradation of the conventional resins is apparent as erosion (loss of gloss in Table 1) and fiber prominence (as seen in Figure 2). Photomicrographs of both control sheet (no exposure) and exposed sheet (four years exposure) are shown in Figure 2.

Table 1.
Results of Four-Year Exposure in Bristol, Pa.

	Gloss*	Color# $\frac{A-B}{G} \times 100$	White Light Transmittance
Commercial Control	47.5	12.3	76.0
Commercial Exposed	5.5	52.0	48.0
P-433 Control	69.3	14.6	77.0
P-433 Exposed	12.5	37.5	51.6
P-444 Control	72.3	0.0	84.2
P-444 Exposed	64.5	17.7	79.1
R & H Acrylic Control	69.3	8.1	50.6
R & H Acrylic Exposed	60.0	20.5	42.5

* Photo volt 60° gloss, according to ASTM D523-53-T; high reading indicates good gloss.

Color measured according to Fed. Spec. TTP-141B Method 613.1; low reading indicates low degree of yellowing.

Data show that the conventional resin (P-433) and the commercial sheet have lost most of their original gloss, have changed color considerably, and have lost a good deal of their capacity to transmit light. On the other hand, P-444 and the R & H acrylic have retained their gloss. In color, the P-444 has changed slightly more than the acrylic; in light transmittance, P-444 is superior. Figure 1 shows how white-light transmittance has changed with time of exposure at three different exposure locations.

Close examination of the sheets has shown that the fall-off in properties of the conventional resins is due to severe surface erosion and polymer breakdown. This phenomenon has been discussed in previous papers

* Numbers in parentheses refer to Bibliography at end of article.

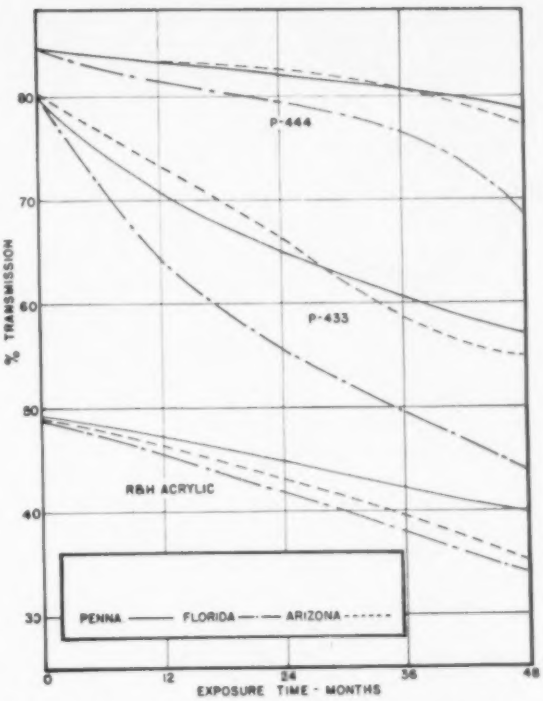

Fig. 1. Light-Transmission Characteristics of Glass Mat Laminates Exposed in Three Locations (Pennsylvania, Florida, and Arizona).

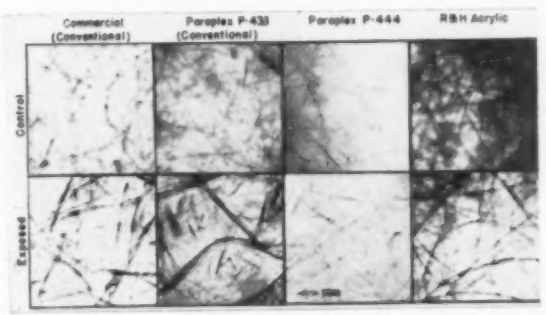

Fig. 2. Photomicrographs of Test Panels after 48-Months Exposure at Bristol, Pa.

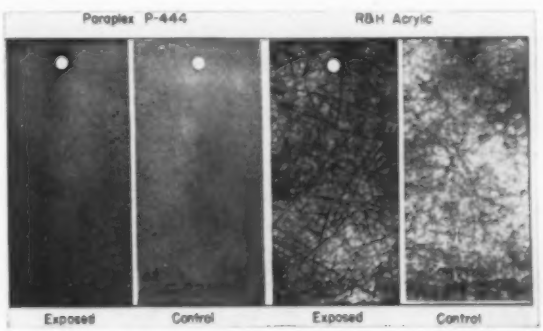

Fig. 3. Test Panels after 36-Months Exposure at Bristol, Pa.

(1,2)*. Microscopic examination shows cracking and crazing of the polymer and erosion of the surface exposing the glass fibers. In Figure 2, low-power magnification shows how the glass fibers become prominent, start to collect dirt, and reduce over-all light transmission. After four years, the P-444 is essentially unchanged. The R & H acrylic shows fiber prominence and dirt collection which reduces light transmission from an already low value, due to differences in refractive index between the glass and the resin. If the light transmission originally were higher, the reduction would be even greater.

Based on these data and observation of the actual exposed samples, it is apparent that substantial improvement has been made over conventional styrene-based polyesters. Comparing the P-444 with the R & H 100% acrylic, it is apparent that slightly more yellowing occurs with P-444 than the latter. On gloss retention, there is little to choose; but on fiber prominence and the resultant reduction in white-light transmission, P-444 distinctly is better. Illustrating this, Figure 2 shows considerable change on exposure of the R & H acrylic, while P-444 essentially shows no change.

Figure 3 shows another comparison of P-444 with R & H acrylic. In the exposed acrylic, the resin has separated from the glass fiber, and caused poor light transmission and fiber prominence. The P-444 is essentially unchanged.

As this story started to develop based on early experiments, the decision was made to market Paraplex P-444 because it appeared to be a better product for use with glass fiber. It certainly was disappointing to us at Rohm & Haas to observe this because we had had great hopes for the straight acrylic product. Although at that time we did not know why the straight acrylic did not perform as well as P-444, this was not the first anomaly which had appeared in this new field of reinforced-plastics.

But a researcher is never satisfied until the question "why" is answered. Best possible conditions had been used for all our work, but performance of the acrylic was still poorer than P-444. Investigation was made of many variables including formulation, completeness of cure, etc.

An analysis of the factors influencing durability in glass-reinforced plastics has been made in a previous paper published in June 1959 (2). This analysis explained why acrylics, the most durable of polymers, fail in reinforced plastics. It should be remembered that reinforced plastics distinctly is a new class of material. It assumes the absolute properties of neither of the components parts, but rather is a wedding of glass and plastic to give a new material having different properties. Glass, with its strength, rigidity, and dimensional stability dominates this new material. The plastic is used to bind and knit together the glass fibers. The strength and dimensional stability of the new resultant material forms the basis for its use in corrugated sheet for the building field.

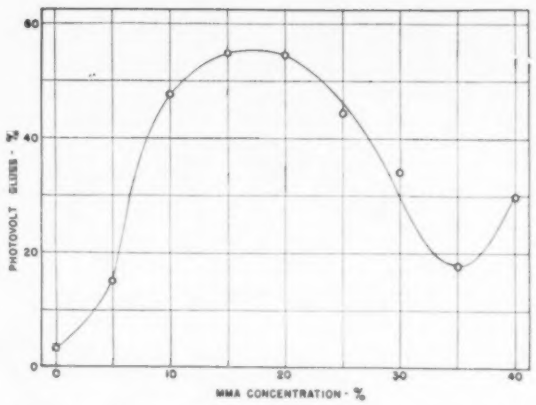

Fig. 4. Gloss-Retention of Glass Mat Laminates Exposed for 24 Months in Florida.

This same high strength and, particularly, dimensional stability place extra demands on the plastics component which are not encountered in normal plastics applications. Although the acrylic polymer durability is excellent per se, the exceptional dimensional stability of the glass induces stresses in the plastic when it wants to (but cannot) expand and contract under influence of daily temperature and moisture changes. These induced stresses result in a pseudo stress-fatigue failure (or stress crazing) which is a phenomenon recognized by experts in acrylic resins.

P-444 is less influenced by changes in temperature and particularly moisture than are acrylics and, therefore, is stressed to a lesser degree in the glass-reinforced (and dimensionally-stabilized) structure. In addition, P-444 is more stress-craze resistant than are acrylics, even at equal stresses. Data and more complete discussion are given in the previous paper (2).

Later Test Results

During the period from 1955 to the present, time has demonstrated the superiority of P-444. The oldest exposure on record has now had almost six years of exposure, and it shows that P-444 has maintained its original appearance. Table 2 shows the composition and gloss retention values for a series of panels made with clear resin and those containing 25% glass fibers:

Table 2.
Compositions and Gloss Retentions of Test Panels.

	Panel 1 P-444 (as is)	Panel 2 P-433 (as is)	Panel 3 P-444 dil.	Panel 4 P-446 dil.	Panel 5 P-443 dil.
Polyester	75	75	60	60	60
MMA	25	—	20	10	0
Styrene	0	25	20	30	40
Gloss retention*	5.2	48.0	83.5	56.5	11.8

* Photo volt 60° gloss, according to ASTM D523-53T; high reading indicates good gloss.

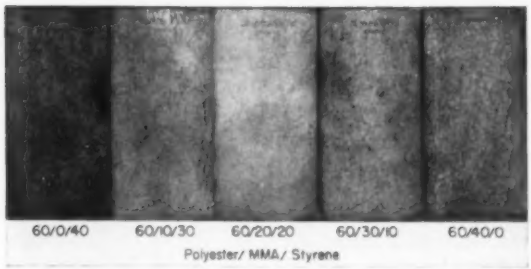

Fig. 5. Polyester/MMA/Styrene Panels Exposed for 24 Months in Florida.

These data not only show the superiority of P-444 dilute (Panel 3) over conventional resins (Panel 5), but also show that a full 20% of MMA, giving a styrene ratio of 1/1, is needed for optimum durability.

These data provide an excellent example of an anomaly in the reinforced-plastics field. Composition 1 consisting of 75 parts polyester and 25 parts MMA is rather poor in durability (gloss retention). Close examination shows that the surface has failed by crazing of the polymer. But here is the anomaly: add styrene and better durability is obtained. (Panel 3 is P-444 diluted).

It is well known that polymers of styrene are poor in durability. On this basis, addition of styrene to the system should result in poorer durability, not better. But in this case, added styrene does not result in unstable polystyrene, but rather supplies a needed link between the difficult-to-copolymerize MMA and the unsaturation in polyesters. Studying these data further, one notes that Panel 3 (75 parts polyester and 25 parts styrene) is far better in gloss retention than the styrene-diluted form (Panel 5). This shows that the polyester per se, when copolymerized properly without too many styrene-to-styrene linkages, is quite durable.

On the other hand, Panel 1 is poor for two reasons:

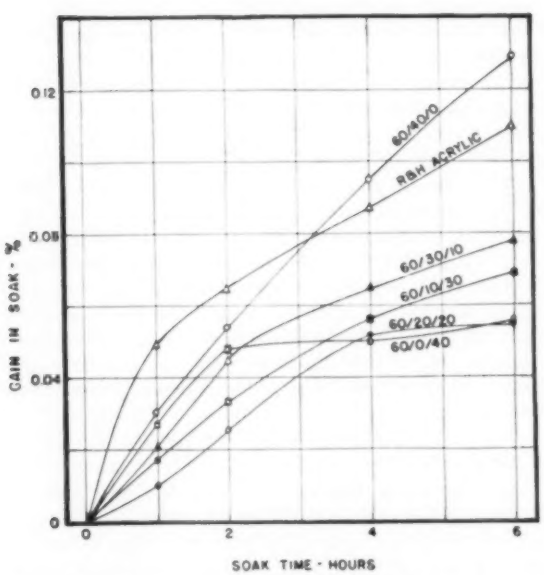

Fig. 6. Short-Time Water Absorption Values of Cast Sheets of R & H Acrylic and Various Blends of Polyester/MMA/Styrene.

(1). The polyester is improperly copolymerized because of the inherently poor copolymerizing tendencies of polyester with MMA.

(2). The poly-MMA constituting the rest of the mixture of polymers is not, in itself, well suited for use with glass fiber.

A more impressive demonstration of these factors is afforded by another experiment. A series of panels with 25% glass fiber were made up and exposed. Compositions were 60 parts polyester and 40 parts monomer. Starting with 40 parts MMA, replacement was made in 5% increments with styrene, until all the monomer was styrene. Results of gloss meter readings in Figure 4 show that there is optimum gloss retention at the P-444 (dil.) composition (60 parts polyester, 20 parts MMA, 20 parts styrene). As one proceeds to either side of this composition, poorer results are obtained. The polyester component, of course, is of fundamental importance. Considerable variation in performance can result from the polyester itself, as discussed more fully in (2). Figure 5 is a back-lighted photograph of this same series. (In order to get a better picture, alternate panels were excluded from the photograph.) The optimum composition (60/20/20) clearly is evidenced by minimum fiber prominence.

Why does this optimum occur? As the styrene is increased from this optimum composition, the copolymer becomes styrene-rich, forming some styrene-to-styrene bonds. Since these are unstable to outdoor weathering, polymer degradation occurs, resulting in poorer performance. Again returning to the optimum composition (60/20/20—polyester/MMA/styrene), as the MMA is increased, poly-MMA is formed which is more susceptible to expansion/contraction due to moisture. In a glass-reinforced structure this causes fiber prominence and crazing of the polymer around the fibers, both of which detract from gloss.

Evidence of this characteristic relative-moisture sensitivity is given in Figure 6. This test, run on cast, unreinforced samples, is similar to the ASTM water-resistance test (D570-42) except that measurements are made at very short intervals in the early stages of immersion. Thus, a rate of water pick-up is measured. Note that the polymer which is best (has the slowest rate of moisture gain) is P-444 (60/20/20). As the monomer ratio is changed in either direction, poorer results are obtained. Styrene (60/10/30 composition) detracts from this optimum much less than does MMA (60/30/10 composition). Note, also, how poor the straight-acrylic resin is. These data are significant because gain in moisture inevitably means expansion. But in a glass fiber dimensionally-stabilized system, this desire to expand is translated into a stress. When drying occurs, an alternate and opposite stress is set up. This alternate stressing results in ultimate crazing and polymer break-down.

Significance of Test Results

After years of exposure, break-down is observed in splitting of the polymer away from the glass fibers, and in polymer crazing. Both of these weaken the structure and collect dirt, reducing the light transmission and detracting from appearance (see Figure 2).

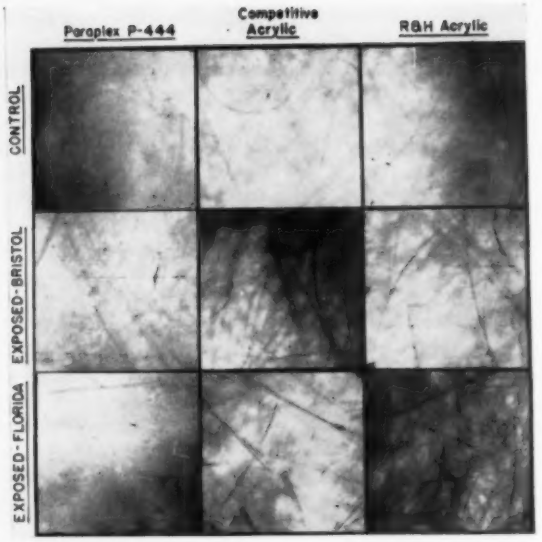

Fig. 7. Comparative Photomicrographs of Test Laminates After 12-Months Exposure.

Table 3.

Flexural Strength Data, Psi., on Exposed Laminates.

	Conventional Resin	P-444
Initial properties	69,300	69,500
Bristol exposure: One year	63,000	65,100
Bristol " Two years	59,200	64,100
Florida exposure: One year	59,300	65,300
Florida " Two years	46,700	60,300

Table 4.

Flexural Strength Data, Psi., on Exposed Laminates.*

	Conventional Resin	P-444
Control	17,500 (3,840)	21,500 (4,850)
Bristol exposure: One year	16,700 (2,590)	22,200 (3,570)
Florida exposure: Two years	19,300 (3,420)	18,200 (3,170)
Florida " Three years	12,400 (2,430)	20,600 (3,430)

* Standard deviation in parentheses

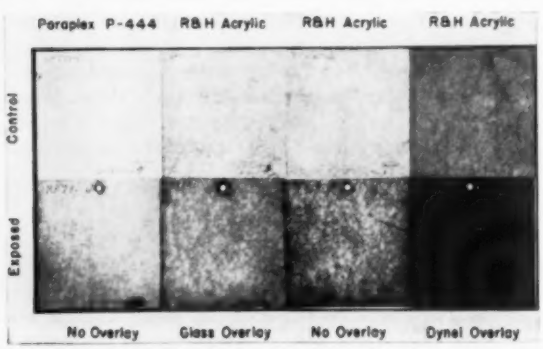

Fig. 8. Various Test Panels After 36-Months Exposure at Bristol.

This type of failure is significant not only in appearance, but also in physical properties. One example of its influence compares P-444 with conventional styrene-based polyester resin. Table 3 lists flexural strength data on 12-ply glass cloth (Volan treated) laminates exposed for one and two years at Bristol and Florida.

It is difficult to realize significant differences in glass mat laminates because of variability in glass concentration and orientation. Table 4 gives data on flexural strength for 25% glass mat-content laminates. Standard deviation showing variability is given in parentheses. These data begin to show how failure of the resin can mean structural weakening of the composite laminate.

Future Test Work

Our work continues, of course, in order to make sure that we offer the best possible product for this field. In recent work, checks have been made on a competitive acrylic resin.

Panels were made up with 25% glass and the resins catalyzed with 1% benzoyl peroxide. Cure was effected in 16 hours at 55° C., plus two hours at 120° C. Results in Figure 7 show the same tendency towards fiber prominence in both acrylic-type resins. The prominent fibers result from rupture of the glass/resin interfacial bond, and from minute crazing of the acrylic resin immediately next to the glass fiber. P-444, of course, shows no change.

It should be emphasized that data reported here are connected with a progress report on work designed to give information, rather than the optimum performance of the final panel. In this interest, experimental panels are made containing 25% glass fibers without use of the several methods to suppress the glass fibers from the surface of the composite. In this way, information on performance is learned more quickly to guide us towards the best possible resin. Once this best resin is attained, then the usual techniques of suppressing glass fibers (such as surfacing mat, or crinkle finish) can and should be used to obtain optimum performance.

Selected specimens from a series designed to investigate influence of surfacing mat are shown in Figure 8. Back-lighted photographs (not magnified) show the improvement afforded by use of glass overlay on the R & H acrylic panel. But it is still no better than P-444 without overlay. The use of glass overlay with P-444 would offer still greater improvement. Note how poor by comparison is the best of several synthetic fiber overlays. In all cases, the synthetic overlays failed by becoming white and opaque. Apparently, the synthetic fiber is so much more susceptible to moisture than the plastic component that repeated swelling and shrinking from moisture has ruptured not only the resin-synthetic fiber bond, but also the surrounding resin as well.

Conclusions

Results taken from extensive actual exposure of glass-reinforced sheet have demonstrated the superiority of acrylic-polyester over straight-acrylic resins. A careful balance of composition is necessary in the polyester. To assure optimum results, a 1:1 ratio of methyl

(Continued on page 56)

Consultant's column Adhesives

DR. S. S. STIVALA*

Q-1. What surface treatments are recommended for achieving optimum adhesion of copper-to-copper, brass-to-brass, and aluminum-to-aluminum, by epoxy type adhesives?

A-1. For many applications, vapor degreasing with tetrachloroethylene provides satisfactory bond strength between adhesive and adherend. However, to achieve maximum adhesion, vapor degreasing of the metal surfaces should be followed by an appropriate chemical treatment.

The following chemical treatments, subsequent to vapor degreasing, should provide improved results for the metals in question:

(a). Copper-to-copper. Immerse the copper metal for two minutes in a ferric chloride-nitric acid solution (30 parts by volume of a 42% aqueous solution of ferric chloride; 60 parts by volume of concentrated nitric acid, sp. gr. 1.42; and 390 parts by volume of water) at room temperature. Wash thoroughly with warm water and air dry.

(b). Brass-to-Brass. Immerse the brass for five minutes in a nitric acid-sulfuric acid-zinc oxide solution (one liter of concentrated nitric acid, sp. gr. 1.42; one liter of concentrated sulfuric acid, sp. gr. 1.84; and 80 grams of zinc oxide) at room temperature. Repeat operation for five minutes at 120° F. Wash thoroughly with warm water and air dry.

(c). Aluminum-to-aluminum. Immerse the aluminum for ten minutes in a chromic acid solution (30 parts by weight sodium dichromate, 300 parts by weight concentrated sulfuric acid, 900 parts by weight of water) at 150° F. Wash thoroughly with warm water and air dry.

In the preparation of the solutions the usual precautions involving the handling and dilution of the mineral acids should be observed.

Q-2. What adhesive can one use to bond cellulose acetate butyrate to magnesium? The bonded surfaces in the end-item must be capable of withstanding vibration and shear stresses from room temperature to as low as —60° F.

A-2. The large difference in the thermal coefficients of expansion of the magnesium and the cellulose acetate butyrate would create severe stresses in the adhesive at —60° F. An adhesive, therefore, should be somewhat elastic at such low temperatures.

A cellulose nitrate adhesive or a Buna N-resin type adhesive should work satisfactorily. It is recommended that multiple layers of adhesive be applied to each bonding surface with a minimum of one hour air-drying time between coats. This will provide a thick adhesive coat for absorbing the stresses created by the differences in the expansion of the adherends.

To improve adhesive bond strength, the surface of the magnesium should be abraded with sandpaper and steel wool to remove the oxide coating, or preferably chemically treated by immersing the metal in a chromic acid solution (68 grams sodium dichromate; 70 ml concentrated nitric acid, sp. gr. 1.42; sufficient water to yield 380 ml of solution) for one minute at room temperature, rinsed with warm water and air dried. The cellulose acetate butyrate should be wiped with a clean cloth dampened with carbon tetrachloride (ethyl alcohol may be substituted for the carbon tetrachloride for production work where ventilation may be inadequate).

Q-3. How can I bond a piece of thick polyethylene tubing to a large polyethylene container? A hole will be bored on the side of the cylindrical wall of the container and the tubing will be used essentially as an outlet tubing. The bonding method must be such that any solvents or other chemicals used in the polyethylene will not attack the adhesive and a good seal must be provided.

A-3. For your application it would be preferable to use polyethylene itself as the bonding agent. This will ensure chemical and solvent resistant properties similar to the adherends. A most effective bond and seal can be obtained by drilling a hole slightly smaller than

(Continued on page 64)

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A new weathering stabilizer for poly (vinyl chloride) plastic
(Cont'd. from page 47)

recently recommended to the trade for outdoor stability; Compositions Q and R. Neither of the two latter Compositions was free of compounding color; each showed a pale brown cast. The superior heat stability of Compositions L, M, and P is evident from Figure 4. The evaluation of the weathering stability of these newer compositions based on HPT has not progressed very far, as yet. However, outdoor exposures up to one year reveal no signs of deterioration, and it seems reasonable to expect them to constitute satisfactory compromises between heat stability and light stability.

The mechanism by which HPT acts to prevent discoloration by light remains obscure. The compound has a strong affinity for hydrogen chloride, producing a white salt. This may contribute to its effectiveness as a light stabilizer, although it is difficult from this viewpoint to understand why it lacks the heat-stabilizing action common to most hydrogen chloride absorbers.

HPT is a rare example of a weathering stabilizer which does not absorb the solar ultraviolet. Moreover, it does not develop any important amount of absorption during exposure in the plastic. Figure 5 shows the near-ultraviolet absorption curves of four-mil thick films of unstabilized PVC (Composition A) and similar films containing 3% HPT before and after exposure for various lengths of time under a General Electric RS-275 sun lamp. The fading of the stabilized film during exposure is shown by the decrease in absorption of the near ultraviolet light. The increase in absorption below 360 mu is very slight, when compared with the absorption of the usual ultraviolet stabilzers. It is even less than the small absorption developed by the unstabilized film.

The stabilizing action of HPT may be analogous to that of antirads which are reported to be effective in protecting plastics against high-energy radiation, without absorbing directly any large fraction of the incident radiations themselves (14). By means of some enormously efficient energy-transfer process, this type of stabilizer must be able to snatch away from the poylmer its absorbed energy quantum before the polymer suffers any damage. After this, the stabilizer then must dispose of the surplus energy in a manner that does not harm the polymer.

Conclusions

This is the sort of light stabilizer which is needed for thin films and fibers. When a light stabilizer of the conventional primary-absorber type is used, the molecules of polymer in the surface layer receive no protection from the stabilizer. Indeed, unless the stabilizer disposes of its absorbed energy in a way that is completely harmless to the surrounding polymer molecules, the surface layer of the plastic would be worse off in the presence of the conventional stabilizer, than in its absence.

Hexamethylphosphoric triamide (HPT) has been found to be an effective weathering stabilizer for PVC. Care is required in these formulations to retain adequate heat stability. A recommended formulation is 100 parts of PVC, 30 parts of dioctylphthalate, two parts of HPT, one part of epoxy stabilizer, and one part of organotin-sulfur stabilizer.

Acknowledgment

It is a pleasure to acknowledge the assistance of Dr. G. M. Armstrong in the compounding and testing of the plastic compositions.

Bibliography

(1). Birnthaler, W., and Falk, G., KUNSTSTOFFE, 49, 439 (1959).
(2). ASTM test method, D747-58T.
(3). Boyer, R. F., J. PHYS. & COLLOID CHEM., 51, 80 (1947).
(4). Fox, V. W., Hendricks, J. G., and Ratti, H. J., IND. ENG. CHEM., 41, 1774 (1949).
(5). "Polymer Degradation Mechanisms," Circ. No. 525, National Bureau of Standards (1953).
(6). Mack, G. P., KUNSTSTOFFE, 43, 94 (1953); MODERN PLASTICS, 31, 3, 150 (1953).
(7). Winkler, D. E., J. POLYMER SCI., 35, 3 (1959).
(8). Fuchsman, C. H., SPE J., 15, 3, 214 (March 1959).
(9). Unpublished results, Chaudet, J. H., Tennessee Eastman Co.
(10). DeCoste, J. B., Howard, J. B., and Walder, V. T., CHEM. AND ENG. DATA SER., 3, 131 (1958).
(11). Perry, N. L., SPE J., 15, 7, 550 (July 1959).
(12). Graham, P. R., Darby, J. R., and Katlafsky, B., CHEM. AND ENG. DATA SER., 4, 372 (1959).
(13). Tamblyn, J. W., and Coover, H. W., Jr. (to Eastman Kodak Co.), U. S. Patent 2,912,411 (1959).
(14). Charlesby, A., in "The Effects of Radiation on Materials," J. J. Harwood, et al., Editors, Reinhold Publishing Corp., New York, N. Y. (1958).

—THE END

Long-term durabilities of polyesters in glass-reinforced parts
(Cont'd. from page 54)

methacrylate to styrene is required. Although straight-acrylic plastics are famous for their durability as a 100% plastic, they are deficient in reinforced-plastics because of their susceptibility to stress crazing. The inherent dimensional stability of glass fiber renders the glass/plastic composite so dimensionally stable that the plastic cannot expand and contract naturally in response to changes in temperature and moisture. This restriction induces stresses which result in stress-crazing failure of the polymer. Acrylic-polyesters do not fail this way, primarily due to better resistance to moisture and to crazing.

The superiority of P-444 over present acrylics is manifested in lack of change in appearance, light transmission, and absence of fiber prominence. It is too early to detect possible changes in physical properties.

Acknowledgment

We are grateful to Mr. S. Chmielewski for photographic work, and Mr. R. W. Hart for exposure studies.

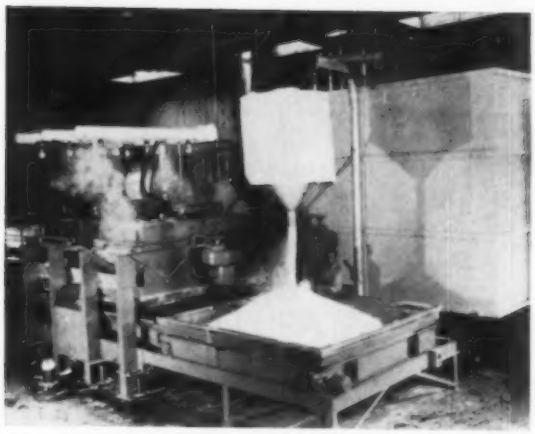
Bibliography

(1). Smith, A. L. and Lowry, J. R., "Unsaturated Polyester Resins Containing Methyl Methacrylate Monomer," MODERN PLASTICS, 35, 7, 134 (March 1958).

(2). Smith, A. L. and Lowry, J. R., "Factors Influencing Durability of Glass Reinforced Polyester Plastics," PLASTICS TECHNOLOGY, 5, 6, 42 (June 1959).

—THE END

Landis molds giant freight car door linings



Dylite beads, entering Cycolac shell, will be foamed in place by this specially designed machine.

Plastics developed by Koppers Co., Inc., and Marbon Chemical Division, Borg-Warner Corp., are playing an important role in construction of new insulated doors now being installed on cars of Pacific Fruit Express.

The first of 1,025 railroad cars in which temperatures may be mechanically controlled from −10°F. to 70°F. have started rolling off assembly lines in Los Angeles. Each has door liners embodying the largest known individual moldings of Dylite expandable polystyrene and Cycolac ABS. Inside the doors, each of which is 9 feet 3 inches by 8 feet 6 inches by 8⅝ inches thick, Dylite forms a tight, moisture proof insulation within a Cycolac shell.

Three years ago, Robert L. Landis of San Jose, Calif., approached Pacific Fruit Express Co. with his idea of combining the superior insulating qualities of Koppers' foamed polystyrene and the tough, rigid qualities of Marbon's ABS thermoplastic resin. After a period of designing and building the necessary machinery, the door liners went into production by Landis Industrial Co., Santa Clara, Calif.

In the manufacture of the door liners, the Cycolac shell is molded first. For this, Comet Industries, Inc., designed and constructed what is claimed to be the largest commercial vacuum forming machine in existence. Sheets of Cycolac are fed into the machine by a roller conveyor. This conveyor for feeding the sheet and removing the formed door shell does the work of four men. Once in the machine, the sheet is secured in the clamping frame. It then enters the oven where it is heated on both sides by electrical resistance rods. Because the oven has a door which closes after the sheet enters, a shorter heating cycle is made possible.

After heating, the sheet is placed in position for the inverted forming operation. The male mold descends, pushing down on the heated sheet until the mold reaches its bottom-most position. At this time vacuum is applied, firmly securing the sheet to the mold. After a short cooling period, the formed door is removed from machine by the roller conveyor. The entire operation is automatic.

Because of the size of sheet available, the operation presently requires the forming of door shells in two parts. The parts are butt-jointed, fastened with staples, and adhesive welded to form the finished door liner, which is now ready to receive its Dylite insulation.

The technique for molding 89-pound cakes of Dylite is unique in that the Dylite is simultaneously expanded and bonded to the vacuum-formed shell.

The molding machine has a movable bed which slides out from under the working portion of the machine to allow the huge liner to be placed in it. Previously the inner portion of the liner had been sprayed with a special Minnesota Mining and Manufacturing Co. adhesive which has hardened. While in the machine, the liner receives 44½ cubic feet of pre-expanded Dylite beads from a hopper directly above. The bed of the machine slides back into operating position under a covering plate containing 645 steam probes which are injected into the pre-expanded beads.

Steam, generated by a boiler and gathered in an adjacent accumulator, is released into the mold explosively. During this process, the loose beads are fused and the dried adhesive is reactivated, welding the foamed material to the shell. The finished Dylite cake is of two-pound density. This operation, like the vacuum forming, is completely automatic.

Pre-expansion of the Dylite beads is accomplished in a Rodman No. 1 Expander, which produces 500 pounds of pre-expanded beads per hours. These go into two bins, holding 2,000 cubic feet apiece, from which they are conveyed to a batch hopper.

Finally, a gasket of a specially compounded du Pont neoprene is secured to the door liner. It is shipped to Los Angeles, where it is attached to a steel door for installation on the cars.

Use of the plastic doors improves insulation and saves 400-500 pounds in car door weight. Since the doors are 2½ feet wider than those previously used, larger mechanical lift trucks and loaders can be used in loading and unloading the cars.

HERCULES Plastics Hi-Lites

Vol. II, No. 3

New Housing Projects, 1960 Style

Product builders achieve significant improvements with Pro-fax® polypropylene

BULLETIN

WASHINGTON, D. C. . . . The Food & Drug Administration has issued a formal regulation, appearing in the Federal Register, authorizing the use of Pro-fax polypropylene in products coming in direct contact with all kinds of food. Pro-fax thus becomes the first packaging material to win approval through the issuance of a formal Food Additives regulation. Author of the successful petition was Hercules Powder Company. Hercules predicts widespread use of Pro-fax in food uses, including packaging films, molded containers, coatings, liners and dispensers used in food handling.

Plastic housings in all manner of sizes and shapes, used in an across-the-board list of products, are among the first big developments of the '60s . . . an exciting clue to things ahead. Materials such as Pro-fax polypropylene are fast changing the face and function of many a product, lending new color and styling appeal, improved performance, and above all—*lower cost!*

Measured by yesterday's standards the achievements of today's new materials border on the impossible: they provide high resistance to heat, moisture, household chemicals, foods and cosmetics. They offer rich color and are ideally adapted to the attractive styling requisite for modern merchandising. Yet because they are low-cost materials, adaptable to rapid cycle injection-molding, they are *priced right!*

No wonder that just about every new plastic housing project you see these days is a Pro-fax project. Here are a few of the latest.

AROUND THE YARD

A handsome Pro-fax housing is the new symbol of quality on today's modern power mower. An excellent example is this high-styled motor shroud for the 1960 Power-Matic. Its beauty belies its rugged strength, for this sturdy housing is virtually unbreakable and will permanently resist heat, moisture, gasoline, oils and greases. Molded-in mountings eliminate the need for metal parts in the assembly, providing a design that is completely corrosion-proof. In addition to the Power-Matic shroud, Amos Molded Plastics, Edinburg, Indiana, has designed, developed and produced a series of similarly well-engineered Pro-fax mower housings for Power Equipment, Cicero, Indiana, and its value-conscious customers.

IN THE KITCHEN

Pro-fax in the kitchen spells new convenience and satisfaction for homemakers. Knapp-Monarch's Redi-Matic automatic can opener-knife sharpener features a gleaming white Pro-fax housing, and as a result is impervious to damage from staining and rough handling. The Redi-Matic automatically opens cans of all shapes, and sharpens knives of all sizes. Thanks to Pro-fax, it's a luxury styled unit designed to blend beautifully with any kitchen decor.

Molded by: Warren Molded Plastics, Cortland, Ohio.

ABOUT THE HOUSE

Fast becoming standard home accessories, vaporizers and humidifiers have gotten a big boost in appearance and function by the use of Pro-fax. The new Northern automatic vaporizer/humidifier (shown here) features a bowl and lid molded with Pro-fax, in contrasting colors, which combine in a compact, easy-to-carry appliance that is both useful and attractive wherever it serves in the house.

Pro-fax bowl and lid molded by Cruver Manufacturing Company, Chicago, Illinois.

IN THE NURSERY

Modern style and top performance go hand in hand in Formulette's bottle warmer. It's molded with Pro-fax, of course, for a luxury finish plus resistance to heat and moisture, in a rigid, thin-walled, lightweight unit that is easy to handle, always safe and the ultimate in completely sanitary nursery equipment.

Molded by Boonton Molding Company, Boonton, New Jersey, for Formulette Company, Inc., Jamaica, New York.

IN THE LUNCH BOX

Breadwinners, too, enjoy the convenience and luxury of Pro-fax. The handle, jacket, and collar of Aladdin's new Dura-Clad vacuum bottle, with its unique "Pitcher-Pour" handle, are all molded in one piece with Pro-fax. Pint-size (shown here in use) fits all workmen's lunch kits while the quart size (appearing in the background) is designed to fit conventional outing kits. Both models are heat-, scratch-, and stain-proof.

CP60-9

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

HERCULES

THREE NEW MATERIALS FOR THE PLASTIC INDUSTRY

HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

The film and sheet extruding industry . . .
. . . more competitive than most others, has had good economic reason to seek out and develop new techniques and machinery to improve quality while increasing material output. Approximately 40% of all thermoplastic resins used in this country is converted into film and sheet products of one form or another; in fact, film represents the largest single use of any plastic material. Since the manufacture of quality film is a critical operation, much research and experimental work has been carried out, both on the development of special resin grades and on the design of specialized equipment.

Most film producers are well aware of the properties required of their products. Each has had a hand in furthering the art, and in adding data to the manuals of his industry. Some of the specifications mentioned in the latest handbooks and manuals are worth reiterating.

1. Film must be free of blemishes and dirt inclusions (oxidation and degradation products).
2. Film must be free of "fish-eyes" (non-homogeneous plastic particles that pass through screen pack filters).
3. Film must be clear and, in most cases, have a high surface gloss without excessive "blocking" tendencies.
4. Film must be uniform in thickness throughout its length and across its width.
5. Film and sheet material should not differ greatly in strength across the width from that in the machine direction.
6. Finished rolls of film must be tight and free from folds and wrinkles.
7. Reeled film should be as free of static electricity as possible.
8. In the case of sheet, the material should be free of internal stains.

It is obvious from these requirements that items 1, 2 and 3 are mainly the concern of the material producers, although they also reflect the part that cleanliness plays around processing machinery. Items 4 through 8 have to do with the extrusion die and subsequent take-off equipment. This should be the machinery builders' problem; however all too often innovations and improvements on machinery have been made either in operating plants or in the laboratories of the resin manufacturers. Fortunately, some machinery builders are recognizing their responsibilities and are turning their model shops into full-fledged working laboratories. In these situations, a close liaison is taking place between resin producers and the machinery builders.

Generally, the end-use of film or sheet determines the amount of detailed attention required at each stage of the manufacturing process. For example, non-homogeneous material, which would ordinarily ruin film, could be hidden between the walls of a thick sheet. What is termed "applesauce" by some can occur in an extrusion as a result of turbulence in the flow pattern within the die. While not showing to any great extent in heavier sectioned sheet, it would be unsightly and produce a film of reduced strength which might also be porous. The presence of small die lines due either to foreign particles adhering to the die land or a chink in the lips of the die cannot be tolerated in film, but does not materially reduce the strength or

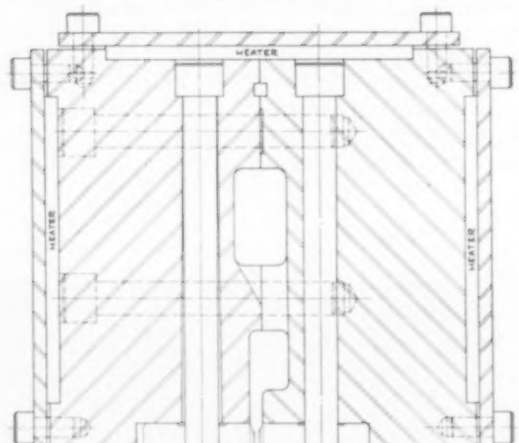


Diagram courtesy: Eastman Chemical Products, Inc.

Composite cross-sectioned diagram of manifold die.

Rear view assembly showing heater connections.

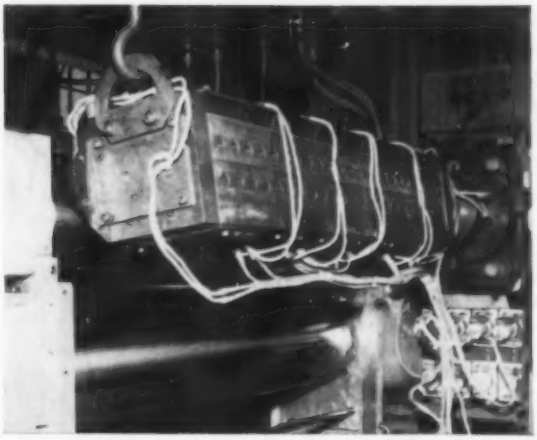


Photo courtesy: Eastman Chemical Products, Inc.

Photo courtesy: Eastman Chemical Products, Inc.

Film gage being modified by springing the movable die lip.

usefulness of thicker sheet.

These few examples underline the need for better techniques and equipment for finer products. Any method or machine that reduces set-up time and/or increases quality is sought after by this industry.

Tennessee Eastman Co., laboratories, Kingsport, Tenn., has developed a new design for a flat manifold die. This die opens down the middle (exposing all channels through which molten plastic flows) for easy cleaning. The die is center-fed, but attached to the extruder at one end. The channel carrying the plastic from the extruder barrel to the center of the manifold is incorporated within the die.

On a visit to the laboratories, I noted that temperature control is simplified since a separate heat control for the feed-channel is unnecessary. The die opens easily for cleaning and, when open, the feed-channel is also exposed. The die can be used for sheet or film as well as for coating substrate materials. It was constructed compactly to fit the draw-off mechanism, a dual unit which handles thin film on one side and heavy sheeting on the other. When the die is to be changed from film to heavier sheet, it is rotated 180 degrees at its point of attachment to the extruder. For extruding into a water bath, the die is rotated 90 degrees so that the film or sheet is extruded vertically downward.

Three sets of die lips have been made for this die, with 1-inch, 3 5/16-inch and 6-inch lands. The first is used for cellulosics in thicknesses of 1-25 mils; the second for cellulosics from 25-75 mils and for ½-75 mil polyethylene. The third is for cellulosics and polyethylene sheeting from 75-150 mils thick.

The die lips are attached to the die. Threaded holes on the face of the lips which meet the die receive bolts, which run through the die and are adjusted from the rear. This leaves a smooth, unbroken surface on the outside of the die lips, and permits a more uniform temperature control within any heating zone. Die lips which have clearance holes for bolts and counter-bores for the bolt heads drilled into them lose heat unevenly around these holes. This causes cool spots to form which contribute to streaking the extrusion.

The die is 42 inches wide and has seven controlled temperature zones; two end zones heated with 1.25 Kw. electrical heaters, and five zones across the die, each heated with a 5 Kw. electrical heater. The total heat available at the die is 27.5 kilowatts. —THE END

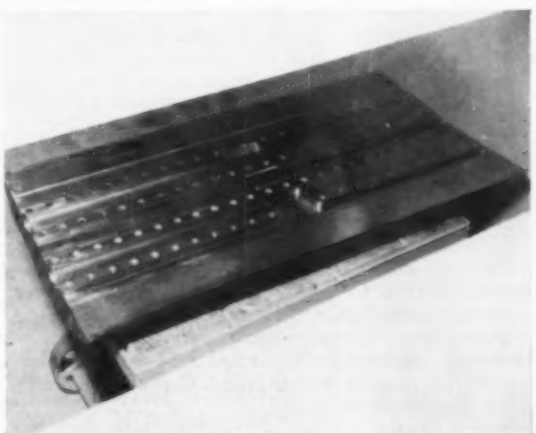
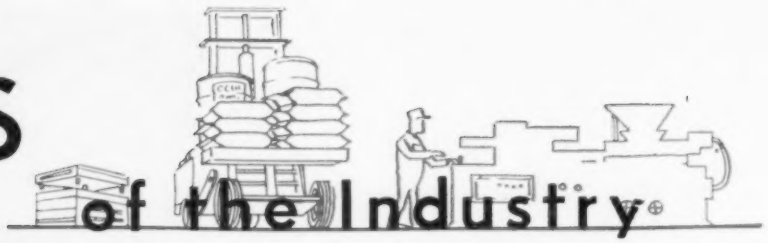


Photo courtesy: Eastman Chemical Products, Inc.

Opened die with end plate and adapter nozzle removed.

NEWS of the Industry



new plants, labs & additions

Allied Chemical Corp. is building a plant at the General Chemical center, Baton Rouge, La., for the manufacture of a new group of fluorocarbon plastics. The first product is a non-flammable material based on chlorotrifluoroethylene, and it can be fabricated by injection, extrusion, and other molding techniques.

Pycofoam Corp. has opened a New York City sales office at 521 Fifth Ave. The firm is a custom molder of Koppers' Dylite expandable polystyrene.

Radiation Applications, Inc., has moved to larger quarters at 36-40 37th St., Long Island City, N. Y.

Witco Chemical Co. is erecting a 30-million pound phthalic anhydride plant in the East, with completion scheduled for late 1961. The installation will use a naphthalene-oxidation process.

Via-Plastics, Inc., has moved from Philadelphia to 12 Bala Ave., Bala Cynwyd, Pa.

Dow Chemical Co. has opened two polyethylene film plants; one in Findlay, O., the other in Fresno, Calif.

Aeroplastics Corp. is adding a new building to its facilities at Venice, Calif. Completion is expected in July.

Delhi-Taylor Oil Corp. is constructing new facilities in Corpus Christi, Tex., for the production of orthoxylene used in the manufacture of phthalic anhydride. Total capacity will be about 70 million pounds annually.

Union Carbide Plastics Co. has moved its Texas district sales office from 1511 Bryan St., Dallas to 6300 North Central Expressway in that city.

Grieve-Hendry Co., Inc., has moved to 1350 N. Elston Ave., Chicago. The firm manufactures industrial and lab ovens.

J. O. Ross Engineering division, Midland-Ross Corp., has erected new Detroit offices at 13050 Puritan Ave.

Hooker Chemical's Durez Plastics division has opened a sales office at 333 West First St., Dayton, O. George A. Shroyer is district sales manager.

B. F. Goodrich Chemical Co. is building a plant in Watson, Calif., for the production of vinyl resins and compounds. Completion is expected later this year.

W. R. Grace's Cryovac division is building a plant at Winchester, Mass., and should be transferring from its Cambridge location sometime this month.

CTL division, Studebaker-Packard Corp., is completing a plastics components plant at Santa Ana, Calif., which should be dedicated this month.

Thermo Electric Co., Inc., Saddle Brook, N. J., has opened a new factory office at Tarzana, Calif. The firm makes temperature measuring systems.

Pittsburgh Chemical Co. dedicated a $4-million maleic anhydride plant at Neville Island. Capacity is 20 million pounds annually.

Dynatech Plastics Inc., is constructing a plant in Santa Ana, Calif. The firm is a custom injection molder, and will have 12,000 square feet of operating space.

E. I. du Pont de Nemours & Co. has opened a multi-million pound-per-year pyromellitic acid and dianhydride unit at the Repauno Works, Gibbstown, N. J.

Hooker Chemical Corp. is constructing a $1½-million semi-works plant at Niagara Falls, N. Y. The firm uses the arbitrary range of $25,000-100,000 annual sales as being semi-commercial.

Ferro Corp. is building a plant for the production of fiber glass mat and color gel coats in North Miami, Fla., to be operated jointly by the fiber glass and color divisions. It will occupy 15,000 square feet.

Skeist & Schwarz Laboratories Inc., has established its main office and laboratory at 101 West 31st St., New York City. The original location at 89 Lincoln Park, Newark, N. J., will continue as a branch office and laboratory.

Holland Color & Chemical Co. has purchased a plant in Holland, Mich., as a warehouse. This will release 80,000 square feet of space in the original plant for conversion to production facilities.

Naugatuck Chemical division, U. S. Rubber Co., is constructing a technical center near its main plant in Naugatuck, Conn. Completion of product research—technical service lab is scheduled for 1961.

Archer-Daniels-Midland Co. plans to erect a multi-million dollar chemical center near Peoria, Ill. Plant operation are scheduled to begin in the spring of 1962.

Synthane Corp. has established warehouse and fabricating facilities in Glendale, Calif. The main plant of this industrial laminate producer is located in Oaks, Pa.

Union Carbide Corp.'s silicones division has completed its process development plant at Long Reach, W. Va.

Oronite Chemical Co., San Francisco, Calif., has purchased the resin making and laboratory facilities at Anaheim, Calif., formerly owned by General Electric Co. Oronite plans to continue the production of alkyd and polyester resins, with increased emphasis on new formulations utilizing its Isophthalic material.

Ceilcote Co., a producer of reinforced plastics ventilating systems and processing equipment, has consolidated its eastern operations into a newly established office and warehouse in Trenton, N. J.

Perforating Industries, Inc., formerly of 336 West Westfield Ave., Roselle Park, N. J., recently moved into its new plant at 602 Commerce Road, Linden, N. J. The 10,600 square foot unit enables the firm to expand production by 225%.

Celanese Corp. of America has acquired a plastics development laboratory in Clark Township, N. J. New plastics research will continue at the central research labs in Summit, N. J.

E. I. du Pont de Nemours & Co. has expanded its facilities for producing TFE fluorocarbon fiber at the Spruance plant in Richmond, Va.

Mobay Chemical Co. has moved its administrative, sales, and engineering headquarters to its new building just outside of Pittsburgh, Pa.

agents, distributors & agreements

Dow Corning Corp. and **Price-Driscoll Corp.** have entered into a non-exclusive patent licensing agreement concerning the use of silicone sprays as mold release agents. Dow Corning is operating on royalty payments under P-D patent 2,639,213 entitled "Mold Parting Surface and Method of Preparation." Price-Driscoll successfuly defended a priority contest against the patent, and ownership is now established.

Plastic Molders Supply, Inc., Fanwood, N. J., has appointed S. L. Abbot Co., Los Angeles, as its distributor in southern California.

Marblette Corp., Long Island City, N. Y., has named Foss Mfg. Co., Twin Falls, Idaho, as sales representative in that state, Nevada, Utah, and Wyoming.

changes in corporate name

Plastic Welding Corp. has changed its name to Weldotron Corp., with main offices at 841 Frelinghuysen Ave., Newark, N. J. The firm manufactures high frequency heating equipment, sealers, and welders.

Charles Crowl Co. has been re-named the Crowl Chemical Corp., and now has two product divisions: Crowlite Thermoplastic and Color-Mica.

Thermolyne Corp. is the new name for Thermo Electric Mfg. Co., Dubuque, Ia., manufacturer of heating and temperature-control equipment.

changes in ownership, new companies

Hexcel Products Inc., Berkeley, Calif., has purchased Applied Plastics Co., Inc., of El Segundo, and will operate it as a division. Hexcel makes honeycombs; APCO, adhesives, coatings, and foams.

Risdon Mfg. Co., Naugatuck, Conn., metal fabricator, recently set-up Risdon Plastics division, which will engage in injection molding operations.

National Geophysical Co., Inc., has acquired Electro Plastics Corp., Dallas, Tex., and will operate some as a division doing vacuum and pressure forming.

Southwest Chemical & Plastics Co. is a new firm in the Houston area which will produce custom blends and dispersions of carbon black and other pigments in polyethylene, polypropylene, and other plastics.

Columbian Carbon Co. has acquired the assets of Ander Chemical Co., Cincinnati, O., for about $3-million. The latter firm makes specialized printing inks.

Russell, Burdsall Ward Bolt and Nut Co., Port Chester, N. Y., and Modern Designers, Hialeah, Fla., have affiliated to form Industrial Plastic Molders, Inc., to injection mold parts on a custom basis. The new firm is located in Hialeah.

General Mills, Inc., has purchased the Daven Co., Livingston, N. J., and Laible Mfg. Co., Manchester, N. H. Both of the latter firms supply parts to the electronics industry.

DeWitt Plastics recently purchased the Lewis E. Hamel Co., Rochester. N. Y. All manufacturing processes will be moved to Auburn, N. Y., home of DeWitt. Hamel manufactured plastic fishings lures; DeWitt, plastics boxes and containers.

Pycofoam Corp., Norristown, Pa., has obtained the manufacturing assets of Regal Plastics, Inc., and will continue to manufacture its line of pin-up display forms.

Eureka Williams Corp. purchased the stock of Napco Plastics, Inc., Napoleon, O., then merged with National Union Electric Corp., which is now the parent company. Napco, an injection molder, will now supply parts for the Eureka vacuum cleaner and will also act as a custom molder.

Air-Lite Products, Inc., has been formed to act as an exclusive sales agent for Plastifoam products—a line of foamed styrene items made by Plastifoam Corp., Rockville, Conn. The new firm is located in Cambridge, Mass.

Insulating Fabricators, Inc., has purchased the Spartanburg, S. C., plant of Continental Diamond Fibre, and set-up a Southern division to do custom fabricating of plastic sheeting.

Flo-Tronics, Inc., and Wilcox Products Co., both of Minneapolis, have merged with the latter becoming an operating division of the former. Wilcox makes precision plastics parts; Flo-Tronic, pneumatic conveying equipment.

Ceramic Fabricators, Inc., has been founded by Armand Hillaire in Lyndhurst, N. J., to do custom fabricating of glass-bonded mica, alumina and the like.

Plastic Extrusion & Engineering Co., Inc., has been established in Westboro, Mass., as a custom extruder Company president, Alfred E. Horka, is the former sales manager for New England Tape Co.

Devcon, Ltd., is the name of a new Canadian firm located in Toronto. The firm will produce Plastic Steel, Devcon F, and other products.

Amity Plastics, Inc., is a new injection molding firm established by Leonard Simon at 182 Merrick Road, Freeport, N. Y. Mr. Simon is the former plant manager for Reliance Plastics.

Control of Modiglass Fibers, Inc., has passed from Nicolet Industries to Reichhold Chemicals, Inc.

Nixon Nitration Works, Nixon, N. J., has been purchased by Nixon-Baldwin Chemicals, Inc., a firm founded by Allen Baldwin, former president of Nixon Nitration Works and George Blasius, president of Cary Chemicals, Inc.

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business developments

Stauffer Chemical Co.'s agricultural chemicals division is marketing polyethylene, ABS, and PVC piping to the farm trade. The molded products division produces the pipe.

Turex Plastics, Nasonville, R. I., has begun production of polyethylene film for the packaging field. Turex is a wholly-owned Rexall subsidiary.

E. I. du Pont de Nemours & Co. is currently offering SR-300, a clear, sunlight-resistant polyethylene film.

Peerless Plastics Co. has activated its blow-molding division in Culver City, Calif.

Heisler Corp., Wilmington, Del., is currently offering custom blended thermoplastic resins, as well as powdered resins for coating and color-dispersion work.

Coast Mfg. & Supply Co., Livermore, Calif., has established a plastics division, headed by John L. Stief. The division molds reinforced plastic parts for the aircraft, missile, and electronic industries.

Raybestos-Manhattan's Manhattan rubber division offers Teflon coverings for steel, aluminum, and bronze rolls, in thicknesses to 30 mils.

Prentice-Hall, Inc., in its weekly "Report on Business" predicts the plastics will continue to replace glass, paperboard, and metal containers, setting new highs in 1960.

Teco, Inc., has established a plastics division in Burbank, Calif. First product will be a molded "Mason Modular Chair."

Lester Engineering Co. recently celebrated its 25th anniversary in business.

Consultant's column
(Cont'd. from page 55)

the outside diameter of your tubing through the cylinder wall. The tubing can then be mounted on a drill press. While the tubing is rotated rapidly around its central axis, the end of the tubing is slowly brought into contact with the polyethylene periphery of the hole in the cylindrical wall. The heat of friction will "spin-weld" the two plastic components into one. The drill press power is then shut. The tubing must be held in place momentarily while the thermoplastic polyethylene again solidifies.

A simple method of obtaining a seal of somewhat inferior bond strength may be used. Thus, if the two polyethylene pieces are held in close proximity (1/32" to 1/64" apart) polyethylene can be used to heat weld the pieces together. This method is similar to sealing containers with wax from a burning candle. A rod, tube, or strip of polyethylene is ignited at one end and held almost in contact with the joint to be sealed. The hot drippings from the burning polyethylene flow into the small crevice between the adherends. The polyethylene seal is completed as the joint to be bonded has been rotated 360°.

(The answer to this question was contributed by Mr. M. J. Bodnar, Chief, Adhesives and Plastics Research Section, Picatinny Research Center, Dover, N.J.)

NOTE: Due to his personal commitments and the pressure of his regular duties, Mr. J. J. Scavuzzo has been forced to discontinue his work on this Forum. Dr. Stivala will carry on in the future. —THE END

Names in the News

A. Allan Bates, vice president of research and development, Portland Cement Association, has been elected president of ASTM. At the same time, **Russell W. Seniff,** manager of research for Baltimore and Ohio Railroad, was elected vice president. **Miles N. Clair,** president of Thompson & Lichtner Co., will continue as senior vice president.

Martin Usab

Martin Usab, former vice president of Rexall Drug and Chemical Co. and director of that firm's plastics processing activities, has been elected president of Dynatech, Inc. Dynatech was formed in March to provide advanced custom plastic injection molding services at a Santa Ana, Calif., plant now under construction.

Melvin S. Cagen has been appointed plant technical superintendent of Kordite Co.'s manufacturing facilities in Macedon, N. Y. He will be responsible for mechanical and process engineering, construction, maintenance, utilities, quality control, development, and technical training.

H. Martin Allard

H. Martin Allard has been selected vice president-plastic of Improved Machinery, Inc. Mr. Allard, who has been chief engineer of plastic molding machinery since 1945, recently completed his twenty-fifth year with the company.

John A. Helgesen and **Richard L. Reid** have been added to the staff of Marbon Chemical Division, Borg-Warner Corp. Mr. Helgesen, now product applications engineer, was formerly in product development, design, and sales with Baxter Co. Mr. Reid, as technical sales representative for Cycolac in central and northern Michigan, will be contacting end-use manufacturers and processers.

Richard J. Thompson has been appointed manager of polycarbonate market development for the chemical materials department of General Electric Co. Before assuming this position, in which he is responsible for market development and long range planning for Lexan polycarbonate resins, Mr. Thompson served as sales development specialist.

Johnstone S. Mackay has been named director of the research and development department of Pittsburgh Chemical Co. As such, he will direct research and development on the company's present products and processes, and research in growth areas. In addition, Dr. Mackay will coordinate the research program with overall company plans.

Howard Bassett has been promoted to development associate in the development department of Union Carbide Plastics Co. With the laboratories for the past 12 years, Mr. Bassett has been concerned with injection and blow molding of plastics.

Charles J. White has been designated technical sales-service representative for calcium carbonate division, Harry T. Campbell Sons' Corp. Formerly in pigment sales with Glidden Co., he will cover east, midwest, and Canadian territories.

General Aniline & Film Corp.'s Dyestuff and Chemical Division has announced four promotions in its research organization. **Dr. R. L. Mayhew** has been advanced to the position of technical coordinator-acetylene derivatives, surfactants, and chemical specialties. **Dr. J. L. Azorlosa** has been named program manager-exploratory polymer research. He will be working at the Central Research Laboratories at Easton, Pa., with **Dr. M. E. Chiddix**, newly appointed program manager-acetylene derivatives and chemical specialties research. **Dr. S. A. Glickman** is replacing Dr. Azorlosa as assistant program manager, acetylene derivatives research.

John J. Reed

John J. Reed has been appointed executive vice president of Casavan Industries, Inc. Formerly manager of market development for Allied Chemical's National Aniline Division, he will now supervise sales and applications of polyurethane and polystyrene foams.

Frank B. Cameron

Edward W. Ward

As a result of a recent reorganization in which the number of operating divisions of Celanese Corp. of America was increased from three to four, several executives have been appointed. Celanese Chemical Co. has appointed **Robert L. Mitchell** to the newly-established position of vice president-planning. Mr. Mitchell, who joined Celanese in 1947, has been serving as director of technical and economic evaluation for the past three years.

Celanese Polymer Co., which was temporarily called Celanese Polychem Co. during reorganization, has announced the appointments of **James W. Flynn,** vice president and director of marketing; **Russell N. Clark,** vice president and technical director; **James E. Wall,** manager of manufacturing; **John F. Howe,** planning director; and **William J. Murphy,** controller. Mr. Flynn, who has held several posts in sales, technical service, and market development, was most recently general sales manager of Celanese Plastics Co. Dr. Clark joined Celanese Plastics Co. as technical director in 1960, after five years as technical superintendent of Dupont's Mylar plant at Circleville, O.

Edward W. Ward and Frank B. Cameron have been appointed, respectively, vice president and director of marketing and vice president and manager of manufacturing at Celanese Plastics Co. Mr. Ward had been director of marketing for the division since 1958. Mr. Cameron, who joined Celanese in 1956, had been serving as production manager of Celanese's Amcelle plant in Cumberland, Md. Other appointments include those of **Martin T. Cloran** as controller, **Frank Brown** as technical director, **Fred L. Symonds** as planning director, and **Harold L. Sheppard** as special assistant to the division president.

Peter J. Neroni has been named regional sales manager of Dayton Dayflex Plastics Co., division of Dayco Corp. From headquarters in Cleveland, he will manage the midwest region.

William M. Marshall has been appointed manager of urethane foam production, plastics division of Nopco Chemical Co. He had been serving as technical service representative for Mobay Chemical Co.

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	1000 SERIES					2000 SERIES						3000 SERIES				
PHYSICAL PROPERTIES OF RESIN	1250*	1225*	1200*	1185*	1160	2250	2225	2200	2185	2160	2150	3250	3225	3200	3185	3160
Average Relative Viscosity (1% Solution Cyclohexanone at 25°C)	2.40	2.25	2.03	1.85	1.60	2.40	2.25	2.03	1.85	1.60	1.50	2.40	2.25	2.03	1.85	1.60
Specific Gravity	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Average Bulk Density (lbs./Cu. ft.)	31.5	33.5	35.0	39.0	41.0	29	32	33.5	35	39	35	26	27	24	23	22
Particle Size (Wet Screen Analysis)	100% Through 40 Mesh Screen	100%	100%	100%	100%	100% Through 20 Mesh Screen	100%	100%	100%	100%	100%	100% Through 20 Mesh Screen	100%	100%	100%	100%
Oil Absorption, Minimum (M1-DOP/g of Resin based on ASTM Method)	—	—	—	—	—	—	—	—	—	—	—	1.25	1.25	1.25	1.25	1.25
Form	White Powder	White Powder	White Powder	White Powder	White Powder	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads	White Beads
PHYSICAL PROPERTIES OF COMPOUND (100 Parts Resin — 50 Parts DOP)																
Tensile Strength (PSI)	2960	2750	2670	2140	1420	2820	2820	2500	2190	1550	1400	2890	2790	2630	2170	1570
100% Modulus (PSI)	1940	1920	1870	1350	1160	1790	1540	1500	1400	1240	1150	1860	1730	1690	1370	1220
Ultimate Elongation (%)	340	300	280	270	166	350	400	400	390	167	150	345	375	380	390	180
Shore A Hardness	88±3	86±3	83±3	80±3	79±3	86±3	84±3	82±3	83±3	79±3	77±3	87±3	86±3	84±3	80±3	79±3

*These resins available in UL-approved Electrical Grades.

PHYSICAL PROPERTIES OF UNPLASTICIZED RESIN — 2000 SERIES (Press Polished Sheets)

	2250	2225	2200	2185	2160	2150
RELATIVE VISCOSITY	2.40	2.25	2.03	1.85	1.60	1.50
ROCKWELL HARDNESS (ASTM D-785-51 Method A)						
R-Scale	118	117	117	117	118	117
M-Scale	61	61	61	61	61	60
IZOD IMPACT (NOTCHED) (ASTM 256-56 Method A) Ft. Lbs./inch Notch	0.8	0.8	0.6	0.33	0.25	0.20
HEAT DISTORTION (ASTM D-648-56)						
264 PSI °C	74	74	73	72	69.5	71.5
264 PSI °F	165	165	163.4	161.6	157.1	158.9
66 PSI °C	85	85	83.5	82.5	80.0	80.5
66 PSI °F	185	185	182.3	180.5	176.0	176.9
TENSILE STRENGTH (ASTM D-638-58T) PSI	8050	8350	8320	8500	6650	5000
MODULUS OF ELASTICITY FLEXURAL ($\times 10^5$) (ASTM D-790-58T)	5.00	4.95	4.93	4.96	5.03	5.10
STRESS AT YIELD (ASTM D-790-58T) (PSI-Flexure)	14000	14200	13900	13700	7100	5500

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Elmer J. Collins

Elmer J. Collins has been named product applications engineer at Marbon Chemical Division, Borg-Warner. Mr. Collins, whose previous experience with Marbon was in product development, returns to the company after 18 months in Turkey as controller for Tumpane Co.

Paul E. Doucette and **Harry Shwerz** have been added to the research and development staff of Hysol Corp. Mr. Doucette, who has been engaged in applications of epoxy resins at Electric Autolite, is now responsible for development of molding and pelletizing powders. Mr. Schwerz is doing applied research.

Murray Neipris has been advanced to the position of plant superintendent by Blanc Corp. Before his promotion he was assistant to the chief chemist, working on research and development projects.

Robert W. Ward

Robert W. Ward has been elected president of the newly-organized Olympic Chemical Co., producers of polyurethane foam. Other officers are **Sydney M. Cone, Jr.,** vice president; **Harold W. Smith,** secretary-treasurer; and **Alan W. Cone,** assistant secretary. Mr. Ward was most recently production manager of Nopco Chemical Co.'s plastics division. He has appointed **Lester W. Bates,** former research supervisor for Hewitt-Robins, Inc., as plant manager.

Edward F. Gurnee, a physical chemist with Dow Chemical Co.'s physical research laboratory, has been advanced to associate scientist. Dr. Gurnee's work has largely been concerned with mechanical and optical properties of polymers.

Stanley C. Prater has been promoted to the position of advertising manager for the chemical division of Minnesota Mining and Manufacturing Co. Mr. Prater joined the advertising department in 1953, and has been associated with fluorochemical products sales since 1956.

William DeWitt, Jr., has been named vice president of DeWitt Plastics, new division of Shoe Form Co., Inc. The company does custom and proprietary blow molding, vacuum forming, extruding, and fabricating.

Noble Sherwood has been designated technical director of the reinforced plastics division, A. O. Smith Corp. He was formerly chief engineer of the company's space-ordnance division.

Foster Nostrand

Foster Nostrand has been named sales promotion manager of the Dapon department of Food Machinery and Chemical Corp.'s chemicals and plastics division. Mr. Nostrand, previously a publicity account executive, will administer and coordinate advertising and publicity for Dapon diallyl phthalate molding resins and Daponite laminate.

Thomas L. Trafford has joined Borden Chemical Co. as engineering manager for the resins & chemicals department. From offices at the Bainbridge, N. Y., plant, he will direct engineering at the Bainbridge, Browntown, Wis., Demopolis, Ala., and Fayetteville, N. C. plants.

R. G. Richards has been named to the newly-established position of director of development, Diamond Alkali Co. Since joining the company in 1952 as a technical service representative, he has served in several positions in research and development.

Kenneth G. Michel

Kenneth G. Michel has been appointed vice president and assistant general manager of Bradley-Sun Division, American Can Co. He will continue to be responsible for operations at the Maynard, Mass., plant.

Charles C. Colozzi has been elected president, and **John J. Grady,** secretary, of U. S. Gasket Co., plastics division of Garlock, Inc. Mr. Colozzi, who was also

Charles C. Colozzi

elected to the board of directors, has been with the company for seven years, most recently as plant manager. Mr. Grady will continue as treasurer, a position he has held since 1958.

Kenneth L. Lyttle has been named advertising manager of Diamond Alkali Co. He comes from American Steel & Wire, Division of U. S. Steel, where he was an advertising assistant for the past four years.

George H. Reed, manager, plastics and chemicals, American Hard Rubber Co., has been elected chairman of the thermoplastic pipe division of the Society of the Plastics Industry, Inc. **John Lainson,** president of Western Plastics Corp., was elected vice chairman. Mr. Reed is succeeded as chairman of the Plastic Pipe Research Council by **George C. Anderson,** manager for product development, National Tube Division, U. S. Steel Corp.

R. M. Paulsen

R. M. Paulsen has been designated director of research for the plastic bottle and tube division of Continental Can Co. He was formerly with U. S. Rubber Co., where he was concerned with development and manufacture of laminates, extrusion, injection and compression moldings, and foamed materials.

Lloyd C. Adam

Lloyd C. Adam has been appointed manager of rubber and plastics machinery division, Taccone Corp. For the past 17 years, Mr. Adam has been in rubber and plastics machinery sales with Erie Engine & Manufacturing Co. as sales manager and vice president. Taccone Corp. has a complete line of presses for compression, transfer, and fiberglass-reinforced plastics molding.

New Materials

For more information check Readers' Service Card (p. 89)

High-Temperature Laminates

Synthane Corp. has introduced two high-temperature industrial laminates: Grade ARF-HT, an asbestos mat plastic; and Grade G3-HT, a glass fabric plastic. Both materials are composed of a modified phenolic resin binder with a recommended temperature resistance of 500° F., and are available in sheets and strips, with tubes for special requirements.

The following properties of the sheet laminates are before exposure. After 1000 hrs. at 500° F., ARF-HT retains 40% of the original flexural strength; 90%, compressive strength; and 40%, tensile strength; while G3-HT retains 40% of its flexural strength; 80%, compressive strength; and 40%, tensile strength.

	ARF-HT	G3-HT
Flexural strength, psi.,		
Lengthwise	35,000	60,000
Crosswise	25,000	50,000
Compressive strength, psi., flatwise	50,000	50,000
Izod impact, ft.-lbs./in., edgewise		
Lengthwise	6.0	10.0
Crosswise	3.0	6.0
Bonding strength, lbs.	1,000	.....
Specific gravity	1.65	1.80
Water absorption, %	0.8	1.5
Tensile strength, psi.,		
Lengthwise	20,000	30,000
Crosswise	12,000	25,000
Dielectric breakdown, KV parallel to laminations, step by step	6.0	30
Dissipation factor, 1 Mc	.....	0.038
Dielectric constant, 1 Mc	.....	5.9

Readers' Service Item 1

Paste Colors for Epoxies

Ferro Corp.'s plastic color section has announced the availability of paste color concentrates for liquid epoxy resins. The majority of the color concentrates are inorganic, and have good light fastness and heat stability. The organic colors have superior color brightness and strength, but their light stability is not as good as that of the inorganic pigments. Selection of organic colors is limited to red, green, blue, and black.

Approximately 1-2% inorganic color pastes of 0.5-1% organic color pastes should be used. Percentages are based on weight of resin plus hardener. These concentrations may be varied widely, depending upon the desired brightness, amount and type of filler and hardener, etc.

Readers' Service Item 2

Rigid Polyurethane Foam

General Latex & Chemical Corp. is producing rigid and semi-rigid urethane prepolymers under the trade name Vultafoam. Supplied as a two-part system, Vultafoam hardens in 10-20 minutes and cures at room temperature. It is unaffected by water, oil, acids, alkalis, and marine life.

Vultafoam is supplied in densities from 2 to 25 pounds per cubic foot. A freon-blown, rigid, polyether type weighing two pounds per cubic foot has a fine cell structure; 90-90% of the cells are closed. This density is especially recommended for floats and docks. K factor (BTU/hr./sq. ft./in./° F.) is 0.11-0.14; yield strength at 10% is 0.34

Readers' Service Item 3

Fluorocarbon Resin

E. I. du Pont de Nemours & Co. has added Teflon 100 to its line of fluorocarbons. Known as an FEP (fluorinated ethylene propylene)-fluorocarbon, it may be extruded or molded in conventional thermoplastic processing equipment. The company expects the material to find wide application in the electronics and chemical processing industries.

Many of Teflon 100's properties resemble those of the TFE resins. However, whereas the TFE resins are rated for continuous service at temperatures up to 500° F., the usual continuous service ceiling for FEP is about 100° F. lower. Like TFE, FEP retains a virtually constant dissipation factor and dielectric constant over a wide temperature range. Volume resistivity is greater than 2×10^{18} ohm-cm. Chemically inert, FEP films exhibit no porosity and low permeability to acids, bases, solvents, and water vapor. Coefficient of friction, static, is about 0.09; dynamic, 0.4. Transparency is good in thicknesses up to 10 mils.

Readers' Service Item 4

Novel Epoxy Resins

A series of epoxy resins, designated Oxiron 2000, is reported to offer economies and properties which should greatly extend the possible uses of epoxies. Developed by Food Machinery and Chemical Corp., the resins are epoxidized polyolefins, rather than condensation products of polyhydric phenols such as bisphenol and epichlorohydrin epoxides; and differ from conventional epoxies not only structurally, but in reactivity and end properties. Cost advantages result from the use of higher proportions of relatively low-priced reactants, and their lighter weight gives greater volume per pound than conventional epoxies. In addition, their cure characteristics mean advantages in handling.

Notable among the characteristics of these resins are superior strength and stability at high temperatures; excellent electrical properties and resistance to chemical attack; high strength-to-weight ratio; and good adherence to glass fibers. They are recommended for adhesive, tooling, electronic, electrical insulation, pipe, chemical, and protective coating uses; as binders for solid fuel rocket engines; and for laminating in the boat and aircraft industries. Typical properties of the uncured resins, amber or light yellow liquids, are:

	2000	2001	2002
Viscosity, poise at 25° C.	1800	160	15
Specific gravity	1.010	1.014	0.985
Epoxy per cent	9.0	11.0	6.9
Epoxy equivalent (g. resin containing 16 g. O_2, representing 1 epoxy group)	177	145	232
Hydroxyl, percent	2.5	2.0	1.9
Iodine number	185	154	—

The resins may be cured with anhydrides for a product with extremely high heat-distortion temperature. Curing takes place at lower temperatures and with shorter time cycles than is possible with other epoxies. An anhydride-glycol curing system for general purposes is characterized by good reactivity at low temperatures. Excellent high-temperature and physical properties result from a peroxide cure, while use of polyamines yields a system with long pot life at room temperature, reactivity at elevated temperatures, and good high-temperature aging properties.

Readers' Service Item 5

Epoxy Plasticizer for Vinyls

Drapex 6.8 is an epoxidized soybean oil specifically designed to provide optimum heat and light stabilizing performance and maximum compatibility in vinyl compounds. Argus Chemical Corp.'s newest plasticizer acts synergistically with metallic stabilizers, especially the barium-cadmium type, to provide better heat and light stability than could be provided by either component alone at the same cost. Outdoor weathering tests indicate that Drapex 6.8 may triple or quadruple the weathering life of a vinyl compound.

Since Drapex 6.8 displays polymeric plasticizer properties, it is recommended

for use in formulations requiring resistance to oils, low volatility, and minimum migration. Its low iodine value (2.0) insures compatibility and long life for vinyl compounds. Unsaturated additives must be excluded from vinyls containing epoxy plasticizers.

Typical properties of a vinyl compound containing Drapex 6.8 are:

Tensile strength, psi	2,600
Elongation, ultimate, %	360
100% modulus, psi	1680
Shore A hardness, immediate	92
After 10 seconds	83
Low temperature flex, °C	—12
Volatility, %, 24 hrs. @ 250° F.	0.72
Soapy water extraction, % weigh loss, 24 hrs. @ 60° C. in 1% Ivory solution	0.64
Oil extraction, % weight loss, 7 days @50° C. in ASTM #3 oil	2.47
Gasoline extraction, % weight loss	3.6

Readers' Service Item 6

Silicone Release Agents

General Electric's silicone products department is producing two silicone fluids which can provide built-in release in hot melt polyethylenes, or better slip in extruded and molded plastics. Known as XF 1030 and XF 1031, they are a combination of a methyl phenyl polysiloxane and a polyoxalkylene ether. Both have a specific gravity of 1.02-1.03 at 25° C. and a pour point of approximately—60° C.

Like most silicone fluids, these are soluble in aromatic and chlorinated hydrocarbons. In addition, they are soluble in many aliphatic hydrocarbons and the lower alcohols including ethanol, and they are self-emulsifying in water.

Readers' Service Item 7

Polyethylene Coating Compound

A high density polyethylene extrusion coating compound developed by Union Carbide Plastics Co. reportedly gives paper impermeability to moisture, grease, and oils. DGDD-7401 natural can be extruded onto paper at commercial speeds in coating weights as low as six pounds per ream. Multiwall bags coated with DGDD-7401 natural are recommended for shipping hygroscopic materials. In addition to high moisture barrier and chemical resistance properties, DGDD-7401 gives bags scuff and abrasion resistance, improved slip properties, and higher heat resistance.

This 0.95 density, 6-8 melt index resin may be applied as fast as 250 feet per minute. Coated substrates may be heat or glue sealed (after treatment).

Readers' Service Item 8

for **PLASTICS** . . . specify the **PROVEN** temperature instrumentation–by **WEST**

- **Complete selection of Controllers to suit Individual Requirements in Extrusion, Injection Molding, Blow Molding, Vacuum Forming and Heat Sealing.**
- **Compact, solid state, free from *vacuum* tube-problems, minimum supervision or maintenance. Specify on Original Equipment or purchase directly.**

Gardsman by WEST

MODEL JP series provides *proportioning* heater control.

MODEL JPT-2 integrates control of *both* heating *and* cooling for frictional heat in extrusion.

MODEL JSB series provides *stepless* heater control within *extremely close* tolerance; especially appropriate for extrusion die or injection nozzle control.

THERMOCOUPLES—complete selection of standard Thermocouples—including melt, bayonet, compression types preferred in working plastics—or send us your specifications on specials.

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the trend is to WEST

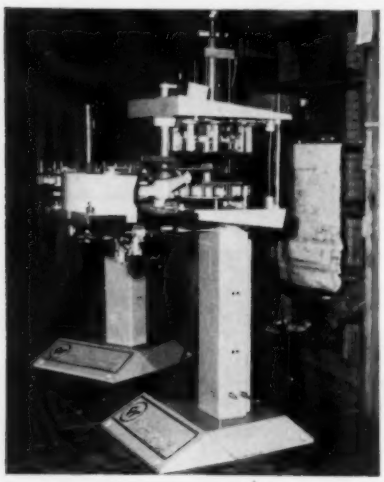
New Equipment

For more information check Readers' Service Card (p. 89)

Polystyrene Sealing Machine

G. T. Schjeldahl Co. claims that its polystyrene sealing machine is the first to seal polystyrene covers to polystyrene containers with a shockproof and crackproof seal. The machine operates with high pressure and low heat.

Products to be packaged can be frozen, wet, or dry. Operating at 15 cycles per minute, the machine will seal packages 9 by 12 by 3½ inches. Polystyrene up to 30 mils thick can be accommodated. The machine is 26 inches wide, 34 inches deep, and 72 inches high.



Sealing machine for polystyrene packages.

Readers' Service Item 21

Flexible Electrical Insulator

Duroid 2100, a combination of Orlon acrylic fibers and an acrylic resin, has been developed by Rogers Corp. for hermetic applications where resistance to freon-oil mixture is a requirement. Typical uses include motor slot liners, wedges, and phase separators. Indications are that many Class "B" type requirements can be met by this natural-colored material. It is currently supplied in rolls 13 inches wide and 0.010-0.030 inch thick.

Specific gravity	1.05
Tensile strength, psi., MD, as rec'd.	10,000
CMD, as rec'd.	5,000
MD, 2,000 hrs. @ 135° C.	6,000
Elongation, %	23.0
Elmendorf Tear, gr./0.001 in., MD	50
CMD	90
Dielectric strength, volts/mil, 60 cycles.	750
Power factor	0.026
Weight, lbs./sq. ft./0.001 in. thick	0.006

Readers' Service Item 22

High Speed Drill Press

Rockwell Manufacturing Co.'s Walker-Turner Division has introduced a 14-inch Hi-Speed drill press with speeds up to 12,000 rpm. Engineered for high speed, small hole drilling where precision and sensitivity are required, it is recommended for all drillable materials, including phenolics.

The drill features a counterbalanced quill to eliminate quill drop at breakthrough on through holes, thus reducing drill breakage and work spoilage. Preloaded, permanently lubricated ball bearings with a 14-spline "floating" sleeve drive assure vibration-free, accurate operation.

Single and multiple spindle models come with No. 72 inch key chuck. Distance between spindle and column is seven inches; between spindle and table, 20½ inches. Quill stroke is 2¼ inches. Diameter of column is 2¾ inches.

Readers' Service Item 23

Shear-Type Slitter-Rewinder

Among the materials for which Appleton Machine Co. designed Model CDH-40 slitter-rewinder is vinyl plastic. The unit, which will handle up to a 90-inch web, can be equipped with razor blade or score-type slitters, as well as standard shear-type slitters. To compensate for caliper variation and insure uniform density, each rewound roll operates independently after slitting. Standard models include edge guides and tension control, and either a four-speed quick change motor drive or reliance variable speed drive.

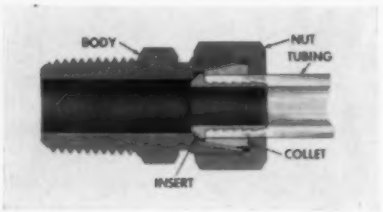
Readers' Service Item 24

Automatic Feeder

An automatic feed attachment to the Comet Meteor, a drape-type thermoforming machine, has been announced by Comet Industries. The attachment is available on new machines, or can be added to equipment now in use. It is reported not only to decrease labor required, but to increase vacuum forming and packaging capacities.

The attachment loads and unloads the clamp frame, feeds roll stock, and slits the formed parts into strips or webs. For the 30 by 36 inch Meteor, the attachment is approximately 42 inches long, 5 inches wide, and 12 inches high.

Readers' Service Item 25



Cross-section of Viseal locking action.

Brass Fittings for Plastic

A brass fitting designed for plastic tubing is now being manufactured by Commonwealth Brass Corp. Viseal fittings are reported to hold without retightening even when subjected to high vibration and internal pressure.

The insert-collet locking action of the fittings is intended to eliminate shifting due to cold flow. A brass insert in one end of the tubing holds the tube firmly and prevents collapsing. A collet fits over the tubing and insert and when the nut is tightened, slots in the sleeve allow it to compress firmly and evenly around the tubing. There is no need to measure torque or count turns. Further, Viseal will not notch or pinch the tubing, even when thin-walled polyethylene is used.

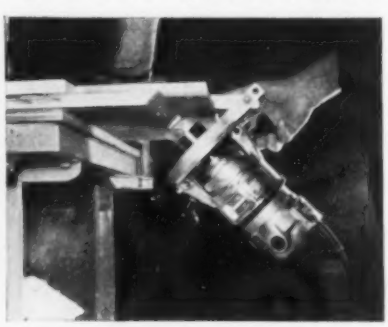
Viseal fittings are sold in all common styles in sizes up to two inches.

Readers' Service Item 26

Mitering Attachment

Knick-March Engineering, Inc., and Porter-Cable Machine Co. recently introduced a mitering device which is attached to a 2½ hp. router. The attachment is designed to produce a perfect mitered edge for laminated plastics, and is expected to be used on counter tops, furniture, displays, and commercial furnishings.

After pieces are fabricated, matching edges are beveled by the router held at



Router in mitering attachment.

angles in the mitering attachment. Glue is applied to both surfaces, which are held in place with cellophane tape until dry. Light sanding may be needed. The resultant joint is stronger than conventional joints because the concave cuts on both surfaces provide more gluing area.

Readers' Service Item 27

Laboratory Extruder

A 1½-inch Thermatic extruder for laboratory and experimental production has been announced by Davis-Standard, Division of Franklin Research Corp. Designed for speeds up to 400 rpm and production rates of 100 pounds per hour at 3,000 psi, model 15 T has separate, high-capacity thrust and radial bearings rated for an average life of more than a half million hours.

Each heat zone along the barrel is equipped with a deep-finned aluminum Therma-Fin and blower, and is provided with a damper for infinite gradients of temperature control. Therm-Fins have cast-in heating elements for proper heating balance. Direct drive to the thrust sleeve from any gear-head motor via timing or V-belts eliminates the need for reduction gears on the drive end of the extruder. Horsepower capacity is 5-25 hp.

Effective screw length at 14.2:1 L/D ration is 21.4 inches; 20:1 L/D ratio, 30 inches; 25.8:1 L/D ration 38.6 inches. The stock screw, of alloy steel with flame-hardened flights, is cored for water cooling. The drive end is tapered and has four splines for positive centering and non-eccentric rotation at high speeds.

Optional equipment on model 15T includes a gas-tight seal at the rear of the feed section, a stainless steel feed section jacketed for cooling, a vent section on the barrel, a barrel pressure gage, and a wide selection of crossheads and dies.

Readers' Service Item 28

Film to Paper Laminator

Operating with standard uncoated plastic films, Rotobond, Inc.'s A-3 laminating machine will coat paper and board at minimum material cost. The machine uses cellulose acetate and other films in thicknesses of 0.0005-0.0075 inch. The 12-inch machine, designed to be mounted on a table 16 by 24 inches, accommodates film in widths of 4-12 inches and board in widths of 4-13 inches. The floor model handles films up to 24 inches wide, and board up to 25½ inches wide.

Both sizes require film furnished on three-inch I.D. cores, wound uniformly to a maximum diameter of 12 inches, and backing paper on three-inch cores with maximum diameters of 9 inches. In widths the same as those of the film being run, backing should be lightweight kraft or newsprint.

Materials are fed at rates of 0-30 feet per minute. Air supply of at least 50 psi. is required. Rewind for laminated material is included.

Readers' Service Item 29

Transfer Molding Press

A 25-ton air-operated transfer molding press, Model 725, has been developed by F. J. Stokes Corp. Designed for use on short production runs where low mold costs and quick set-up are desired, the press converts from transfer to compression molding easily. Controls permit continuous automatic operation or intermittent manual or semi-automatic operation. Powder is fed by an adjustable, three-station rotary feeder.

Air with a working pressure of 100 psi. is ample for operating the press. The force of the main ram air cylinder is multiplied by a toggle arrangement to develop clamping force. Transfer force is obtained by means of a separate air-cylinder, whose pressure can be adjusted independently of the clamping pressure. Model 725 is supplied with both top and bottom ejection systems, and has an air-operated blow-off device to clear the ejected pieces from the molding area.

Small size suits the press for molding extremely small parts such as electronic components. It also is recommended for molding pieces that require inserts. Specifications of the press are as follows:

Model 725 transfer molding press.

Clamp capacity, tons	25
Clamp stroke, inches	5
Transfer capacity, tons	5½
Transfer stroke, max., inches	2½
Ejection stroke, max., inches	2½
Hold-down pin stroke, max., inches	1¼
Distance between platens, open, in.	22½
Distance from bed plate to ram, press closed, in.	12–17
Platen area, L-R x F-B, in.	11½ x 6
Dry cycle time, min., seconds	5
Height, in.	84
Floor space, L-R x F-B, in.	29 x 36

Readers' Service Item 30

Ultrasonic Bubble Detector

Taylor Instrument Cos.'s ultrasonic bubble detector can be used to detect undesirable or controlled bubbling in liquids, foams, and films. According to the company, the detector has been successfully used in long-term production runs by two film producers.

The sensing head assembly, located at the process, is cable connected in a continuous loop with the amplifier unit, which may be remotely located. A pulsed ultrasonic signal, which is interrupted or weakened by the presence of bubbles, passes through the material via transmitter and receiver heads. No air supply or further amplification is required. Output is 0-4 milliamperes into 2,500 ohms (3-15 psi. extra optional); amplifier response time is less than 0.1 second for 63%. Other specifications:

Minimum bubble size detectable, diameter, in.	0.001
Maximum temperature, amplifier assembly, °F	135
Maximum pressure, head assembly, psi.	100
Standard head assembly size, in.	1
Fluid viscosity range, centipoises	1–30,000
Maximum distance between head and amplifier, ft.	20

Readers' Service Item 31

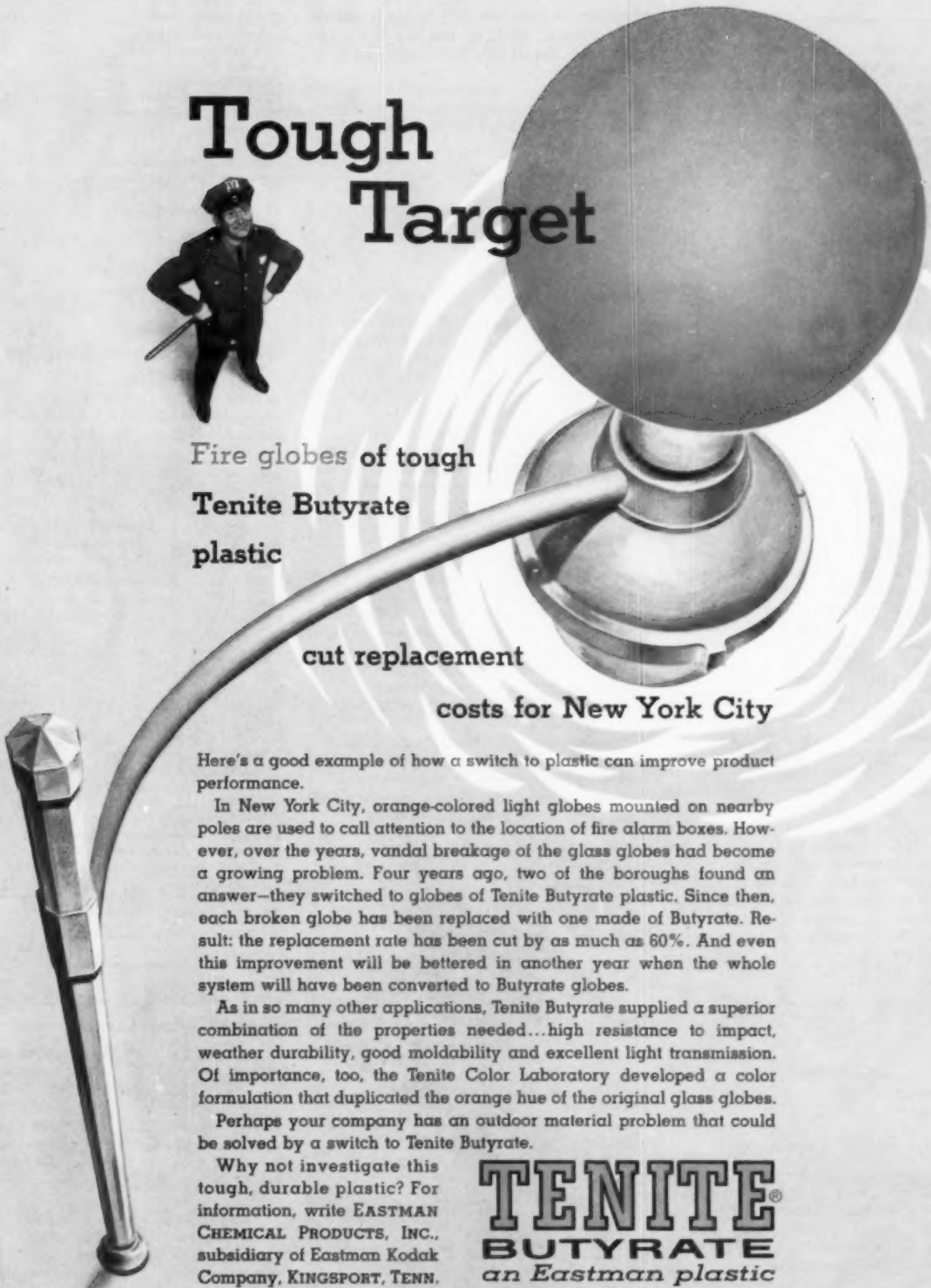
Foam Curing Oven

An oven for curing and cooling spongy plastic materials in 75-foot long sections has been developed by the industrial equipment division of R. C. Mahon Co. The 80-foot, double deck oven will cure and cool two seven-foot wide sections at temperatures up to 300° F. for eight hours or longer. Fin-type coils on top of the oven provide steam heat.

The plastic is fed directly from the extruder-foamer to the threading bar, which carries it into the oven at the rate of 40 feet per minute. When each deck contains 75 feet of sponge, the oven is brought up to curing temperature. During curing, air is recirculated in each of three heating zones at about 5,750 cfm. Fresh air is admitted for cooling.

Readers' Service Item 32

Tough Target



Fire globes of tough Tenite Butyrate plastic cut replacement costs for New York City

Here's a good example of how a switch to plastic can improve product performance.

In New York City, orange-colored light globes mounted on nearby poles are used to call attention to the location of fire alarm boxes. However, over the years, vandal breakage of the glass globes had become a growing problem. Four years ago, two of the boroughs found an answer—they switched to globes of Tenite Butyrate plastic. Since then, each broken globe has been replaced with one made of Butyrate. Result: the replacement rate has been cut by as much as 60%. And even this improvement will be bettered in another year when the whole system will have been converted to Butyrate globes.

As in so many other applications, Tenite Butyrate supplied a superior combination of the properties needed...high resistance to impact, weather durability, good moldability and excellent light transmission. Of importance, too, the Tenite Color Laboratory developed a color formulation that duplicated the orange hue of the original glass globes.

Perhaps your company has an outdoor material problem that could be solved by a switch to Tenite Butyrate.

Why not investigate this tough, durable plastic? For information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENN.

TENITE®
BUTYRATE
an Eastman plastic

Fire globes molded of Tenite Butyrate by A. L. Hyde Co., Grenloch, N. J., for The Welsbach Corporation, Philadelphia 2, Pa., which does street lighting maintenance for the City of New York. Commenting on the considerable reduction in replacements since switching to Butyrate, Welsbach's New York City manager says, *"Butyrate's resistance to shock is so great that no replacement is necessary when the globes are pierced by BB shot or even small bullets. They resist damage from small stones, and even large rocks will only tear the Butyrate, leaving the globe in serviceable condition."*

Plastics Applications

For more information check Readers' Service Card (p. 89)

Pigmented Acorn Lock Nuts

Open-end acorn lock nuts made from Du Pont Delrin have been developed by Russell, Burdsall, & Ward Bolt and Nut Co. for applications in which corrosion resistance and reusable locking action are desirable. The Delrin nuts offer excellent strength, rigidity, dimensional stability, and resistance to water and organics. They can be used for lawn furniture, toys, hotel luggage racks, and other light duty applications.

No. 10 and ¼-inch sizes are available. Since the nut forms its own thread as it is assembled, the No. 10 size fits both 10-24 and 10-32 threads, and the ¼-inch size fits ¼-20 and ¼-28 threads. Colors are metallic gray, metallic gold, and off white. The nuts have a holding strength of 500-600 pounds under straight tension for the No. 10, and 600-700 pounds for the ¼-inch. Prevailing torque is 8-10 inch-pounds for No. 10 and 10-14 inch-pounds for ¼-inch, while stripping torque is more than 20 inch-pounds for the former and 25-30 for the latter.

Readers' Service Item 41

Packaging Foam

A high-density polyurethane foam for packaging applications has been introduced by Leewood Corp. Called Leefoam, it is supplied as an integral part of custom suspension packages or separately in the form of corner pads or blocks. Reported to offer high resistance to shock impact with minimum thickness and cushioning area, the material has high compression strength, low compression set, and good resistance to vibration. Leefoam is efficient over a wide range of static loading, performing well from 0.5 to 2.0 psi.

Readers' Service Item 42

Industrial Respirator

Molded polyurethane foam forms an integral part of an industrial respirator which permits plant personnel to breathe safely at temperatures up to 300° F. Consisting of a foam cylinder holding 65 layers of aluminum screening, the respirator is manufactured by American Optical Co. Using the respirator, and wearing protective clothing, workers can spend up to half an hour in kilns, ovens, or furnaces.

Essentially, the device is a heat exchanger. The foam shell is a three-inch O. D. cylinder with ½-inch walls. Layers of aluminum screening are fitted and locked into the semi-rigid shell, which insulates them from high ambient temperature. The entire cartridge is three inches long and weighs six ounces, including a face piece of soft rubber. It may be attached to an aluminized asbestos hood for very high temperatures.

American Optical Co.'s respirator.

Foamed polyurethane, based on diisocyanates such as those produced by Allied Chemical's National Aniline Division, was selected for the cartridge because of its light weight, insulating properties, and heat resistance.

Readers' Service Item 43

Heat-Resistant Coating

Dyna-Therm 65, a lightweight, flexible, coating material capable of withstanding tremendous heat, was developed by Dynatherm Chemical Corp. to protect launching pads and various missile components. According to the company, Dyna-Therm 65 has proven effective in protecting a neoprene-jacketed umbilical cable used in the firing of an Atlas missile. The material is claimed to permit savings in money and time required to replace components and ground equipment usually destroyed in missile firings.

Dyna-Therm 65 resists flame of 4,000° F.

Field tests indicate the material will be effective under temperatures as high as 6,000° F. When heat is applied, the coating expands and bubbles, providing an insulation for the material underneath. It has potential use as a fire barrier in private and commercial aircraft and in factories.

Swedlow, Inc. has been appointed sales agent for the product in the United States and Canada.

Readers' Service Item 44

Two-Layer Butyrate Sheet

Laminated butyrate sheet suitable for vacuum forming signs has been announced by Rowland Products, Inc. The sheet, which is extruded in two colored layers, can be decorated after forming by simply sanding off the upper layer to produce a raised design of different color.

Sign formed from laminated butyrate sheet.

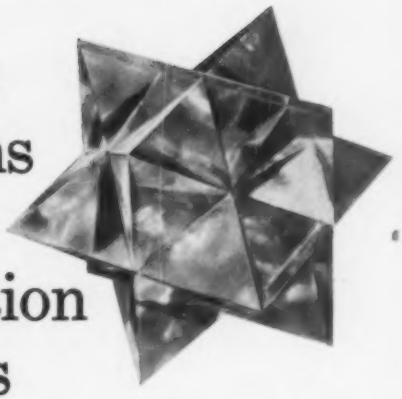
Manufactured from Eastman Chemical Products, Inc.'s, Tenite butyrate plastic, the glossy two-ply sheet takes the same vacuum forming technique as a single butyrate sheet of equal thickness. The sheet is currently extruded in combinations of crystal with red, white, or blue; in widths o. 24 inches and lengths up to 54 inches; and in thicknesses of 45-125 mils. Custom lengths will also be supplied, and possible color combinations include the full range of butyrate standard sign colors.

Readers' Service Item 45

Polystyrene Telephone

The Aristocrat FL.50 is currently being manufactured by Autophone, Ltd., London. Molded in Distrene 475 polystyrene, the

Prompt solutions to your production puzzlers



MONSANTO TECHNICAL SERVICE recently .... recommended the one cement among hundreds that solved a molder's sealing problem and cleared the way for the production of a unique plastics cream-dispensing container .... employed a revolutionary system (developed by Monsanto) for measuring styrene colors, duplicating a customer's color sample with an accuracy never before attainable .... custom-formulated a new material to deliver the desired combination of properties required in a manufacturer's newly designed end product.

These are typical of the many different jobs this department does regularly to help promote customer success. There are Monsanto Technical Service field men on constant call to unravel knotty plastics production line problems on the spot—and keep manufacturers fully informed about new materials, processes, and testing methods. The Customer Service Laboratories draw on a wealth of experience and accumulated data to evaluate specific needs. Objective material recommendations can be made because of the wide range of Monsanto products and formulations.

Molders, extruders, designers, converters, laminators, processors, manufacturers all profit today from Monsanto technical guidance in producing better looking, better operating, better selling plastic products. Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.

MONSANTO ACTIVATOR IN **PLASTICS**

Monsanto

FREE: If you would like this plastic puzzle, just ask your Monsanto Representative.

EXTRUDERS—AUXILIARY EQUIPMENT ISSUE

The September issue of Plastics Technology will carry the exclusive, annual tabulation of the latest data on extruders, blow-molding machines and auxiliary equipment.

In addition, there will be these exciting editorial features:

Fixed Orifice Pressure Control for Extruders by Bruce Maddock of Union Carbide Plastics Co.

An article on blow molding by T. C. Broadwell of Dow Chemical Co.

Determining Costs in Blow Molding & Molding Shops by D. Dearle of North & Judd Mfg. Co.

Plus other articles of value to **you.**

Don't miss Plastics Technology's September issue.

PLASTICS TECHNOLOGY
630 Third Avenue
New York 17, N. Y.

The Aristocrat FL.50.

phone is available in five colors. Handsets can be interchanged for two tone finishes.

A hand recess is molded into the rear of the telephone for carrying or holding it. The cradle is splayed at the rear to ensure correct placement of the handset.

Readers' Service Item 46

Butyrate-Foil Laminate

A lamination-extrusion of foil Tenite butyrate is reported to give individual butyrate sign letters a sparkling brass, chrome, or copper finished frame or edging that retains its metallic luster despite outdoor exposure. Sign letters are produced by Jewelite Signs of Silvatrim extruded by Glass Laboratories, Inc. Silvatrim, consisting of a layer of metal foil between two thicknesses of clear or colored butyrate, is flexible enough to conform to letter shapes. It is welded into place with solvent cement.

Letter faces are cut from transparent Kodapak sheet extruded by Eastman Kodak Co. Material both for Silvatrim and sheet is supplied by Eastman Chemical Products, Inc. Letter faces are available in eight styles in heights from four inches to six feet. Thicknesses range from ½-3 inches.

Readers' Service Item 47

Decorative Metallized Laminate

Fasson Products has introduced self-adhesive metallized Mylar-vinyl laminates for use as decorative trim. The tough Mylar surface film protects the underlying metallic deposit. The subsurface vinyl film, ranging in thickness from four to 12 mils, provides body and permits embossing.

Available in rolls, strips, and sheets, the material is adaptable for many types of trim. Further processing by die cutting, silk screening, and hot stamping makes possible a variety of finished parts, nameplates, and labels. Finished materials are applied by removing the backing paper and pressing into position.

Readers' Service Item 48

Blown Film
COOLING CAPACITY

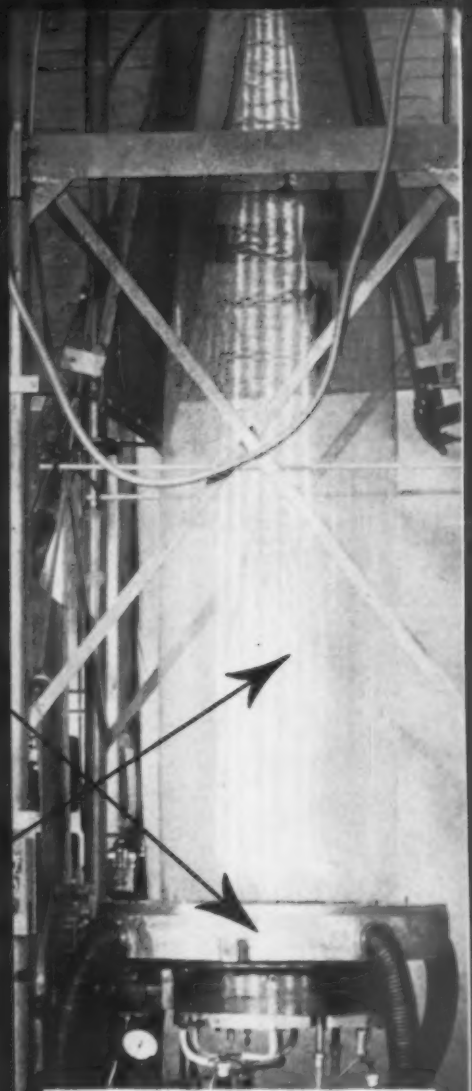
1.
D-S
Air Ring performance here . . .

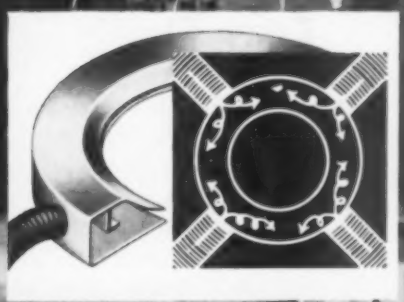
2.
provides faster "bubble" cooling for higher production speeds . . .

Exclusive D-S Velocity Control Air Ring

design prevents lopsided air distribution. Internal baffles provide "engineered turbulence" to evenly distribute air flow around entire circumference of die.

PRECISION EXTRUSION CONTROL IS OUR BUSINESS





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Thermatic
20 WATER STREET, MYSTIC, CONNECTICUT

Name _____

Title _____

Company _____

Street _____ *State* _____

Grace Plastic Helps Create New Idea in Spark Plug Testing

An entire set of spark plugs can now be tested at the service station in *less* time than it takes to remove and test *one* plug by methods used only a year ago. This advantage frees the mechanic to provide other services to his customers and at the same time creates a climate for increased sale of spark plugs. This idea is made possible by a lightweight electronic spark plug tester whose housing is molded of Grex high density polyethylene.

Developed and manufactured by Heyer Industries, Inc. for The Champion Spark Plug Company, the Champion Plug-Scope makes it possible for any serviceman to test spark plugs without removing them from the engine. He simply makes the necessary electrical connections and "reads" the condition of the plugs on a cathode ray tube. The Plug-Scope is well suited for use under rugged garage and service station conditions. The housing of Grex is rigid, strong and durable. It is impervious to damage by gasoline, lubricants and other chemicals. Its lustrous black finish is virtually unaffected by sunlight and outdoor exposure.

The new spark plug tester provides economic advantages to both Heyer and Champion. Your new product idea could prove to be equally profitable.

Find out more about high density polyethylene by calling in the experts. Grace has the production, technical, and marketing facilities to help put your product in the Grex profit parade. Everyone says we're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION
CLIFTON, NEW JERSEY

Efficient production methods made possible by Grex properties.

The manufacturer of the Champion Plug-Scope, Heyer Industries, Inc., reports four ways in which production economies are realized through the use of Grex.

1. *Holes accurately punched.* The excellent machining qualities of high density polyethylene are put to good use in manufacturing the Plug-Scope. Heyer employs standard machine shop presses to punch clean, accurate holes in the plastic housing. The need for a costly cam-action mold is thus eliminated.

2. *Speed nuts are used.* The ribs of the Plug-Scope housing are molded thin so that speed nuts may be pressed into the ribs and held captive for blind assembly. It is Heyer's experience that most other plastics crack when this time-saving technique is used. Grex, however, has the necessary strength and resiliency to withstand breakage.

3. *Undercut molded into nose.* The Plug-Scope's nose section is molded with an undercut so that it snaps over the mated parts of the housing and holds them together. This is an advantage during assembly operations. Molding such an undercut is made practical because high density polyethylene remains flexible at mold removal temperatures.

4. *Self-tapping screws hold firm.* Name plates are attached to the housing by means of self-tapping screws instead of using more costly or time-consuming fastening methods. Heyer finds that self-tapping screws work very well with Grex while many other plastics would crack or not hold them at all.

These design and production ideas take full advantage of Grex to save time and money in manufacturing a superior product. Do you have ideas of your own on how to get the most from high density polyethylene? If so we would like to hear from you and help you work the ideas out.

Technical Service Department
W. R. Grace & Co., Clifton, N. J.

Extruded Light Diffusers

Two extruded plastic diffusers for fluorescent fixtures are designed to provide increased intensity of light on work areas, higher fixture efficiency, excellent 45° cut-off, and uniform low surface brightness. Manufactured by Sheffield Plastics, Inc., the styrene diffusers are known as Directo-Lite and Tu-Tone.

Directo-Lite diffusers, of clear styrene in wrap-around form, have molded prismatic striation to cut off glaring spots. In the area between 45° and the ceiling, the design on the sides refracts light to the ceiling.

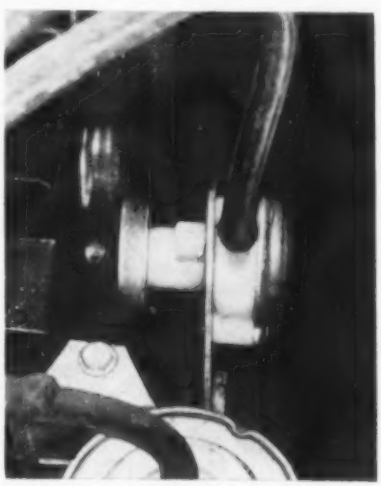
Tu-Tone diffusers are made with white translucent sidewalls and a clear bottom. The latter, with prismatic control of light, confines light output within the 45° working area immediately below the fixture. Outside this cone, the bottom has glare-free, uniform low surface brightness. The two tone effect is reportedly achieved at a cost no greater than that of regular one color styrene diffusers.

Readers' Service Item 49

Windshield Washer Pump

The tiny but efficient pump for the windshield washers on the 1960 Fords and Mercurys is injection molded from Delrin acetal resin. Developed by Delman Co., the part is a gear-type, vacuum-actuated unit driven off the fan belt.

Chemical resistance of this E. I. du Pont de Nemours & Co. resin eliminates internal corrosion which could cause plugging of the spray nozzles and fittings. The plastic is also heat resistant, strong, and dimensionally stable in the presence of water.



Injection molded Delrin pump.

Readers' Service Item 50

Shock Absorbent Door

Clark Door Co. has developed a shock absorbent door in which flexible urethane foam is used to cushion pounding caused by inplant trucks and dolleys. Nopcofoam, a product of Nopco Chemical Co., is used as a buffer between the door surface of the door and a shock absorber panel.

Nopcofoam-padded door.

Readers' Service Item 51

Water Tank Jackets

White insulating jackets molded of plastic foam keep water tanks cold and eliminate a condensation of moisture. The jackets are molded of Dylite expandable polystyrene, a product of Koppers Co., Inc., by Kalamazoo Plastics Co. They are currently being used on water softeners and conditioners supplied by Culligan, Inc.

Readers' Service Item 52

Decorative Laminate Papers

By modifying its Dapon diallyl phthalate resin, Food Machinery and Chemical Corp. has developed Daponite laminating material for furniture, home construction, and household equipment.

The resin is rolled or dip coated on paper stock which can be clear or patterned. The paper is then applied to plywood, hardboard, chipboard, or other flat, smooth surface. When heated in a press under moderate pressure, the resin impregnates the core and cures. When used with natural wood veneer or paper stock, the resin allows the pattern and grain to show through clearly.

Unlike melamine and phenolic laminating resins, diallyl phthalate does not create water as it polymerizes. Further, the laminate surfaces are inherently resistant to water and alkalies.

Readers' Service Item 53

New Literature

For more information check Readers' Service Card (p. 89)

"Industrial Trucks: What Do They Cost?" "Why We Use Battery Electric Industrial Trucks." "Industrial Truck Costs: Propane and Electric Industrial Truck Cost Studies." "Industrial Truck Costs: Gasoline and Electric Industrial Truck Cost Studies." Exide Industrial Division, Electric Storage Battery Co. 62 pages. These four booklets, available as a unit, tell precisely how to calculate the costs of owning and operating industrial trucks powered with electricity, gasoline, or propane. Cost histories and formulae allow calculation and comparison of all expenditures.

Readers' Service Item 61

"Resins for Emulsion Polishes." Form S-71. Schenectady Varnish Co., Inc. 20 pages. After a brief discussion of alkali-soluble resins and wax-compatible terpene-phenols for use in wax- and polymer-based emulsion polishes, the booklet is devoted to suggested formulations, preparation techniques, polish evaluations, and test methods.

Readers' Service Item 62

"Electronics Engineer's Guide to Silicones." Dow Corning Corp. 12 pages. This guide explains how various physical forms of silicones contribute to reliability, miniaturization, modularization, and environmental protection; increase serviceability over wide extremes of temperature; and aid value engineering. Processing information, important electrical and mechanical properties, and typical applications are detailed.

Readers' Service Item 63

"Maraset Electrical Resins Selector." Marblette Corp. 6 pages. Processing information and properties of Marblette's "E" series of epoxy formulation for potting, impregnating, dipping, and coating electrical and electronic equipment are tabulated. Materials included are rigid and flexible potting resins; thixotropic pastes; varnishes; and polyurethane foams.

Readers' Service Item 64

"Design Guide." Anchor Plastics Co., Inc. 72 pages. A catalog of custom cross sections which Anchor has extruded is preceded by a discussion of extrudable thermoplastics. A general article on designing extrusions is also included.

Readers' Service Item 65

"'White Gloves' Plastic Molding." Chicago Molded Products Corp. 12 pages. The brochure outlines and illustrates a melamine and urea custom molding service. The service is especially recommended for those who seek purity of color in white and pastel components.

Readers' Service Item 66

"Improve Heat Sealing by Modifying Equipment." U. S. Industrial Chemicals Co. 2 pages. Among problems caused by improper design or use of heat sealing machinery on polyethylene are non-uniform seals, weak seals, and film sticking to the sealing jaw. A table lists the problems, possible causes, and corrective measures.

Readers' Service Item 67

"Handle With Care." Reichhold Chemicals, Inc. 1 page. An 11½ by 15 inch yellow poster spells out useful remedies for the most frequently encountered hazards in handling methyl ethyl ketone peroxide. The three-color, heavy stock poster is useful for wall mounting.

Readers' Service Item 68

"Flame Resistant One-Shot Polyether Flexible Foam." TIB No. 48-F18. Mobay Chemical Co. 3 pages. The bulletin reports on a technique of adding TCEP to polyether foam mixes to decrease their burning rates and eventually make them self-extinguishing. Included are technical data showing the effect of different amounts of TCEP on the flammability characteristics of foam based on a polypropylene ether triol.

Readers' Service Item 69

"Processing Merlon Polycarbonate Resin by Injection Molding." TIB No. 44-M2. Mobay Products Co. 4 pages. Information on material preparation, machines, mold design, lubrication, and molding conditions is presented.

Readers' Service Item 70

"Grade XX-7." Bulletin 3.1.15. Taylor Fibre Co. 2 pages. The bulletin describes a post-forming phenolic resin laminate which has a creped paper base so that it can be easily drawn and formed. With fair electrical characteristics, the resin may be used for fan blades, formed panels, bulkheads, and ribs and side panels.

Readers' Service Item 71

"Vibratory Finishing." Bulletin No. 600. Lord Chemical Corp. 12 pages. By means of photographs and drawings, the booklet demonstrates equipment features and operating principles and presents examples of deburring and finishing applications accomplished by the vibratory method. Specifications and design features of five Lorco models are listed.

Readers' Service Item 72

"Daponite Laminating Guide." Food Machinery and Chemical Corp. 24 pages. This guide recommends materials, equipment, and production techniques for users of Daponite laminate. Based on diallyl phthalate resin, Daponite laminates are recommended for wood veneers and almost any kind of core material.

Readers' Service Item 73

"Handling and Storage of Toluene Diisocyanates." Bulletin C-3. National Aniline Division, Allied Chemical Corp. 15 pages. Pictures and text explain the best methods for unloading tank cars and trucks, handling drums, constructing storage tanks and transfer lines, cleaning storage tanks, and disposing of spillage.

Readers' Service Item 74

"First in Imagination . . . First with Reality." Automatic Transportation Co. 12 pages. The bulletin outlines the development and design of industrial trucks. It also catalogs some of the company's line, and suggests what may be expected from trucks in the future.

Readers' Service Item 75

"Standard Resins Chart." Emerson & Cuming, Inc. 1 page. A 37 by 24 inch colored wall chart tabulates physical and electrical properties, features, and major uses of casting and impregnating resins, coatings, adhesives, and ceramic encapsulents for electronics applications.

Readers' Service Item 76

"Production of Urethane Foams." Isocyanate Products, Inc. 8 pages. Materials, equipment, design assistance, and engineering know-how for the production of urethane foams are described. It deals with applications of flexible and rigid foam-in-place resins for low temperature insulation, packaging, cushioning, and encapsulation.

Readers' Service Item 77

"1960 Price List and Index of American Standards." American Standards Association. 72 pages. Nearly 1,900 approved standards, including recommendations of international standards committees, are listed in 20 categories.

Readers' Service Item 78

Book Reviews

"ASTM Standards on Plastics." Eleventh Edition. ASTM Committee D-20 on Plastics. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Cloth, 6 by 9¼ inches, 1224 pages. Price, $9.00.

Published in December, 1959, the 1960 edition of the Compilation of Standards on Plastics contains 213 standards, of which 22 are new, and 23 revised or changed in status. In addition to standards prepared by Committee D-20, the compilation includes selected standards from other committees which should be of interest to those in the plastics field. Contents are indexed according to subject and numerically.

Among topics covered are specifications for molding compounds and base materials; standard and molded shapes; mechanical properties of plastics; effects of radiation; thermal properties of plastics; optical properties of plastics; permanence properties of plastics; analytical methods for plastics; molds and molding processes for plastics; definitions and nomenclature of plastics; conditioning of plastics; electrical insulating materials; rubber and rubber-like materials; adhesives; color and gloss tests; and miscellaneous.

"British Plastics Year Book—1960: A Classified Guide to the Plastic Industry." Thirtieth Edition. Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S. E. 1, England. Cloth, 6¼ by 9¼ inches, 696 pages. Price, 42s. ($5.80).

The year book is divided into nine sections, the first of which defines technical terms, tabulates physical properties of ordinary plastics, and lists new companies registered during 1959. Classified lists of materials suppliers, manufacturers and their products, and engineering and chemical equipment follow. A glossary of trade and proprietary names connected with the industry covers materials as well as finished goods. Each trade name is followed by a definition of the product and the manufacturer concerned.

Nearly 7,000 firms associated with plastics are listed in either the United Kingdom or overseas section. A Who's Who lists prominent persons in the British plastics industry.

"The Degradation of Polymers by Ultraviolet Irradiation: Part 1—When Subjected to Radiation of the 'Near' Ultraviolet Region in Air." A. L. Alexander, F. M. Noonan, J. E. Cowling, and R. E. Kagarise, U. S. Naval Research Laboratory. PB 151411, OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 12 pages. Price $.50.

Stability of a number of typical polymeric coatings exposed to ultraviolet radiation were rated by spectroscopy during preliminary Navy research to develop suitable coatings for space vehicles. After irradiation from a near-ultraviolet source at ambient conditions for 300 hours, relative stabilities of materials roughly paralleled the relative order of stability to gamma radiation.

Materials tested, in order of decreasing stability, were: polystyrene, melamine formaldehyde, urea formaldehyde, styrenated alkyd, soyal oil alkyd, silicones, and PVC. A significant observation was that infrared spectroscopy is effective for quantitatively following chemical changes induced by ultraviolet.

"An Improved Device for the Formation of Superfine, Thermoplastic Fibers." K. D. Lawrence, R. T. Lucas, and J. A. Young, U. S. Naval Research Laboratory. PB 151412, OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 8 pages. Price, $.50

A machine for reproducing lots of superfine thermoplastic fibers of a given material has been modified to increase control of process variables and impart improved appearance and uniformity to the fiber. Changes, described in this bulletin, include a nozzle which reduces shot formation, a heating block and cooling system which reduces warmup time, and collection unit which improves fiber laydown, giving it an excellent edge definition.

"Statistical Summary No. 3." Manufacturing Chemists' Association, Inc., 1825 Connecticut Ave., N. W., Washington 9, D. C. Paper, 8½ by 11 inches, 37 pages. Price, $1.00.

This third supplement to the fourth edition of "Chemical Statistics Handbook" contains tabulated data on wage, hour, employment, production, and price trends in the chemical industry as compared with all manufacturing through 1958.

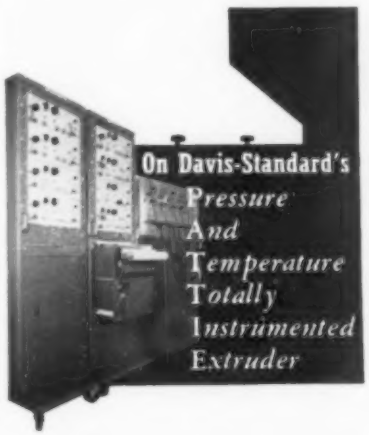
"The Corrosivities of Plastic and Rubbers." H. A. Perry, Jr., and others. U. S. Naval Ordnance Laboratory. PB 151750, OTS, U. S. Department of Commerce, Washington 25, D. C. Price, $1.25.

Some plastics and rubbers can corrode metals in humid surroundings. The cause seems to be the release of electrolytes which are dissolved in water films and droplets on metal surfaces in concentrations heavy enough to bring galvanic corrosion. The most corrosive plastics appear to be phenolic molding compounds, foams, and casting resins. Three techniques for testing corrosivity are described.

Complete

EXTRUSION DATA

Recordings



Davis-Standard has installed in their Extrusion Laboratory a completely instrumented extruder in order to provide precise research data in the study of . . .

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*With acknowledgment to the work of all major chemical laboratories and especially to the achievements of Dr. E. C. Bernhardt of E. I. DuPont De Nemours & Co. and Bruce Maddock of Union Carbide Chemical Co.

Patent Digest

Materials

Composition Containing Polymethylol Melamine and an Ammonium Salt of a Copolymer of an Unsaturated Monocarboxylic Acid and an Alkyl Ester of Such an Acid. No. 2,906,724. J. H. Daniel, Jr., Old Greenwich, Conn. (to American Cyanamid Co., New York, N. Y.).

Stabilizers for Vinyl Halide Polymers. No. 2,902,465. A Bavley, Brooklyn, and C. J. Knuth, Flushing, N. Y., and M. W. Miller, N. Stonington, Conn. (to Chas. Pfizer & Co., Inc., Brooklyn, N. Y.).

Cellular Polyurethane Reaction Product Containing Polysiloxane and Method of Preparing Same. No. 2,901,445. R. F. Harris, Penns Grove, N. J. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Treatment of Perfluorochloroolefin Polymers. No. 2,902,477. E. Fischer, K. Weihsermel, and G. Bier, Frankfurt am Main, Germany (to Farbwerke Hoechst AG, Frankfurt am Main, Germany).

Aqueous Dispersion Containing Oxidizing Acid, Phenol-Aldehyde Resin, and Polymer of Vinyl Acetate. No. 2,902,459. J Teppema, E. Gloucester, Mass. (to Borden Co., New York, N. Y.).

Thermosetting Resin from a Liquid Butadiene Polymer and Styrene. No. 2,903,440. R. G. Heiligmann, Columbus, O. (to Esso Research and Engineering Co., Linden, N. J.).

Cellulose Triacetate Composition. No. 2,902,383. L. F. Beste, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington Del.).

Resinous Materials Plasticized with a Methoxybenzene Dicarboxylic Acid Ester. No. 2,902,382. C. A. Burkhard, Alplaus, N. Y. (to General Electric Co.).

Linear Polyesters and Polyester-Amides from 1,4-Cyclohexanedimethanol. No. 2,901,466. C. J. Kibler, A. Bell, and J. G. Smith, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.)

Curable Glydicyl Polyether-Polyamine Compositions. No. 2,901,461. V. Auerbach, N. Plainfield, and A. K. Ingbermann, Middlebush, N. J. (to Union Carbide Corp.).

Extrusion Apparatus. No. 2,894,623. R. A. Walton, Edwardsville, Ill. (to Dow Chemical Co., Midland, Mich.).

Molding Composition Comprising Synthetic Resin and Metallic Filaments, Articles Molded Therefrom and Method of Making Same. No. 2,901,455. A. W. Jurras, Detroit, Mich. (to Union Carbide Corp., New York, N. Y.).

Apparatus for Extruding Plastic Material. No. 2,893,056. G. E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

Injection Molding Machine. No. 2,896,257. R. M. Norman, R. W. Powell, and K. E. Sherer, Richmond, Ind. (to National Automatic Tool Co., Inc., Richmond, Ind.).

Apparatus for Rotational Casting of Vinyl Resins and Similar Plastisols. No. 2,893,057. P. Rekettye, Akron, O. (to Sun Rubber Co., Barberton, O.).

Plastic Heat-Sealing Apparatus. No. 2,893,468. W. R. Fieroh, Chicago, Ill.

Injection Molding Heating Cylinder. No. 2,894,286. E. Gaspar, M. G. Munns, and P. F. Harrison, London, England (to Projectile and Engineering Co., Ltd., London, England).

Methyl Methacrylate Polymer Composition Containing a Liquid Mixed Polyester Plasticizer. No. 2,898,318. D. H. Coffey and D. J. Guest, Blackley, Manchester, England (to Imperial Chemical Industries, Ltd.).

Polymeric Vinyl Esters Plasticized with Dialiphatic Esters of Certain Alkylidene Dibenzoic Acids. No. 2,898,319. J. C. Petropoulos, S. Norwalk, Conn. (to American Cyanamid Co., New York, N. Y.).

Polyamide Resin-Epoxy Resin and Emulsions. No. 2,899,397. D. Aelony and H. Wittcoff, Minneapolis, Minn. (to General Mills, Inc.).

Heat Stabilized Vinyl Plastic Compositions, Floor Tiles Made Therefrom, and Method for Preparing the Same. No. 2,899,398. A. E. Pflaumer, Norristown, Pa.

Methyl Cellulose Coated Polyester Tape. No. 2,897,099. C. de Ganahl, Greenlawn, N. Y.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each
—The Editor

Low Viscosity Polysiloxanes and Compositions Prepared Therewith. No. 2,899,403. D. W. Lewis, Pittsburgh, Pa. (to Westinghouse Electric Corp., E. Pittsburgh, Pa.).

Metallized Copolymers of Acrylonitrile and Vinyl Chloride. No. 2,897,098. H. J. Homer and J. R. Whitacre, Dayton, O. (to Commonwealth Engineering Co. of Ohio, Dayton, O.).

Vinyl Aromatic Polymers Stabilized with Ureides. No. 2,894,933. W. K. Schweitzer, Jr., Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Epoxy Resins-Plastisol Electrical Insulating Materials and Method of Making Same. No. 2,892,808. J. H. Shafer, Erie, Pa. (to General Electric Co.).

Interpolymers of Acrylonitrile, an Allyl Alcohol and a Styrene Compound, Process of Preparing Same and Coating Composition Therefrom. No. 2,900,359. E. C. Chapin, Springfield, and R. F. Smith, Ludlow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Method for Coating Polyfluoroethylenes. No. 2,898,228. F. M. Kelley, Simsbury, Conn. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Apparatus for Heating Plastic Material in an Extruding Machine. No. 2,893,055. R. H. Wenzel, Temple City, Calif. (to Farrel-Birmingham Co., Inc., Ansonia, Conn.).

Unsaturated Polyester Vinylmonomer, Heterocyclic Nitrogen Monomer, and Method of Preparing Laminated Article Therefrom. No. 2,898,259. C. E. Wheelock, Bartlesville, Okla. (to Phillips Petroleum Co.).

Production of a Cellular Polyvinyl Polyester Plastic Composition. No. 2,898,312. W. Szukiewicz, Forest Hills, N. Y., and A. R. Steimle and P. H. Rhodes, Cincinnati, O. (to Philip H. Rhodes, Cincinnati, O.).

Curing of Epoxy Resins. No. 2,899,407. H. A. Cyba, Chicago, Ill. (to Universal Oil Products Co., Des Plains, Ill.).

Plastic Testing Machine. No. 2,892,342. W. Goss and E. R. Andrews, Pittsfield, Mass. (to General Electric Co.).

Epoxy Resins. No. 2,892,809. W. E. St. Clair, Pittsburgh, Pa. (to Koppers Co., Inc.).

Patent Digest (Cont'd.)

Vinyl Chloride Interpolymers. No. 2,898,244. R. H. Martin, Jr., Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Apparatus for Molding Liquid Resin Materials. No. 2,892,214. L. A. McCarthy, Haverhill, Mass. (to Western Electric Co., Inc., New York, N. Y.).

Polyurethane of a Polyisocyanate, an Active Hydrogen Compound and a Resinous Polybasic Acid and Method of Preparing Same. No. 2,907,718. S. O. Greenlee, Racine, Wis. (to S. C. Johnson & Son, Inc., Racine, Wis.).

Styrene Polymerization Process. No. 2,907,756. K. W. Doak, Pittsburgh, Pa. (to Koppers Co., Inc.).

Curing Epoxy Resins. No. 2,907,748. D. J. Lieb, Bainbridge, N. Y. (to Borden Co.).

Equipment

Extrusion Apparatus and Processes of Extruding. No. 2,901,770. R. H. Beck, Fair Haven, N. J. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Molding Machine. No. 2,900,662. G. A. Scherry, Berkeley, Ill. (to Grayhill, Chicago, Ill.).

Apparatus for Molding a Hollow Container with an Integral Handle. No. 2,900,666. W. Marcus, Cleveland, O.

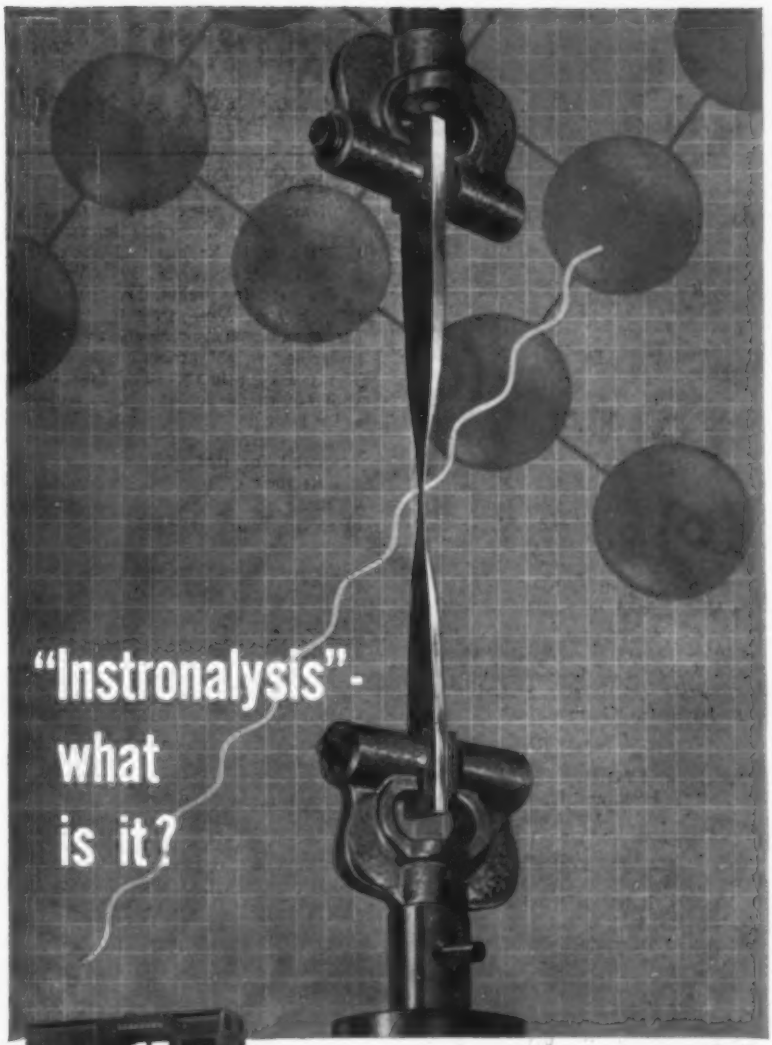
Appartus for Making Plastic Articles. No. 2,901,769. O. B. Sherman and L. D. Soubier, Toledo, O. (to Owens-Illinois Glass Co.).

Method and Device for Extruding Tubes of Thermoplastic Materials. No. 2,902,716. R. Colombo, Turin, Italy (to S.A.S. Lavorazione Materie Plastiche di M.I. Colombo & C., Turin, Italy).

Means and Method for Making Tubes from a Thermoplastic Material. No. 2,900,665. J. H. Walker, Los Angeles, Calif.

Rotary Machine for the Automatic Vacuum Forming of Continuous Thermoplastic Bands. No. 2,902,718. G. Martelli, N. Martelli, and F. Martelli, Bologna, Italy.

Encapsulating Die Roll System. No. 2,902,802. F. E. Stirn, Monsey, and A.S. Taylor, Spring Valley, N. Y. (to American Cyanamid Co., New York, N. Y.).



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Article Abstracts

Materials

"Epoxide Resins—A Literature Survey," B. I. Buck, BRIT. PLASTICS, 32, 10, 475 (Oct. 1959).

Current progress in the production and evaluation of curing agents is the subject of this review. An extensive bibliography is provided covering applications, reactions, modified epoxide compounds, testing, plasticizers, and stabilizers.

"Adhesive Strength of Bonding Agents for Plastics," K. Thinius and G. Grosse, PLASTE U. KAUTSCHUK, 6, 5, 218 (May 1959).

The bonding strength to different plastics is examined of elastomer- and plastics-based adhesives, including Russian, East German, and Czechoslovakian products. Adhesion of these products to rubber, metals and siliceous materials also is considered. (In German.)

"A New PVC for Plastisols—Vestolit SB 70," G. Wick and G. Weber, KUNSTSTOFFE, 49, 9, 455 (Sept. 1959).

This new PVC polymer, specially developed for making PVC pastes, has a lower emulsifier content than other types of Vestolit, is less affected by water, and yields pastes with lower viscosity. Its properties and the various suitable processing methods for it are discussed. (In German.)

"Epoxide Monomers as Initiators of Polymerization," E. Behnke, KUNSTSTOFF-RUNDSCHAU, 6, 6, 217 (June 1959).

Reactions occuring when polymerization is initiated by monomeric epoxides are discussed, with special reference to their use with unsaturated polyester resins. The differences in gelling time and in properties when styrene oxide is employed instead of the usual peroxides are shown, and data are presented to explain the reaction. Possible applications of the products thus obtained also are mentioned. (In German.)

"Polyisocyanurates — A New Diisocyanate Film-forming Material," K. Thinius and G. V. Hintzenstern, PLASTE U. KAUTSCHUK, 6, 6, 275 (June 1959).

When dicarboxylic acid diamines were reacted with tolylene diisocyanates, polyuride-type substances were obtained which, when further reacted with tolylene diisocyanates in presence of a catalytically active solvent, yielded a new polyisocyanurate film-forming material. Later experiments showed that film-forming material could be produced from tolylene diisocyanate alone, without polyuride components. (In German.)

"Osmotic Measurements in the Examination of Macromolecular Substances. II," H. Hellfritz, K. Kramer and W. Schneider, KUNSTSTOFFE 49, 8, 391 (Aug. 1959).

The need for preliminary testing of the selectivity of semi-permeable membranes for osmotic measurements to determine molecular weight generally is recognized. The use of primary standard substances with known molecular weight, and standard substances with inherent or artificially-induced narrow distribution have been suggested for that purpose. The authors discuss their own further findings as well as those of others, on the large number of such substances.

"Properties, Chemical Compositions, and Crystallinity of Polyamide Plastics," A. Muller and R. Pfuger, KUNSTSTOFFE, 50, 4, 203 (April 1960).

The origins and properties of many newer types of polyamides are discussed.

"Testing Suspension PVC for Fish Eyes," O. Leuchs, KUNSTSTOFFE, 50, 4, 227 (April 1960).

When testing different mixes of plasticized black PVC on a laboratory mill, different PVC types show different behavior and can be classified conveniently.

"Glass Fibers as Reinforcing Agents for Plastics—Significance of Glass Composition, Structure, and Surface Characteristics," K. A. F. Schmidt, KUNSTSTOFFE, 50, 4, 234 (April 1960).

A precise knowledge of the chemical and physical properties of glass fiber-reinforced plastics is shown to be essential for the design, engineering, and processing of these materials.

"Color Stability of Vinyl Compounds Pigmented with Iron Oxides," A. K. Woernle, SPE J., 16, 5, 535 (May 1960).

A condensed ANTEC paper showing that excellent color stability may be obtained with commercial-grade compounding ingredients.

"Effect of Rate of Loading on Shear Stress of Resin Adhesives," Raymond Braune, Melvin Silberberg, and R. H. Supnik, SPE J., 16, 5, 553 (May 1960).

A modified NATEC paper on the need for isolating causes of bond failure in resin-adhesive systems.

"Physical Properties of Filled, Low-Density Epoxies," K. D. Cressy, SPE J., 16, 5, 557 (May 1960).

Epoxy foams with good insulating properties are described.

"Inorganic Polymers," F. G. R. Gimblett, TRANS. PLASTIC INST., 28, 74, 65 (April 1960).

The preparation and properties of the phosphonitrile chlorides are described.

"Instrument for Measuring the Permeability of Plastics Sheeting to Moist Gases," N. Buchner and G. Shricker, KUNSTSTOFFE, 50, 3, 156 (March 1960).

General conditions for usage, accuracy of values obtained, and potential applications of the test method and new instrument are described.

"Properties, Processing and Fields of Application of Reinforced Plastics," M. Hagedorn, KUNSTSTOFFE 50, 3, 168 (March 1960).

A report on the recent symposium held by the British Plastics Federation.

"Calculation of Two-Dimensional Temperature Fields in the Heat Sealing of Thermoplastic Sheeting," H. Frielingsdorf, KUNSTSTOFFE, 50, 3, 154 (March 1960.

A mathematical solution of this problem is given.

"Flow Properties of Rigid PVC," G. Plato and G. Schroter, KUNSTSTOFFE, 50, 3, 163 (March 1960).

Test results are given on influence of PVC type, and amounts of lubricants and stabilizers.

"Use of Cellulose Membranes for Osmotic Measurements of Hot Polyolefine Solutions," W. Schmieder, KUNSTSTOFFE, 50, 3, 166 (March 1960).

Adding a swelling agent to the hydrocarbon extends the life of the membrane.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article apears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in October. The last listing appeared in the July issue.

Equipment

"Cast Steel Molds for Plastics Processing," V. con Reimer, KUNSTSTOFFE, 50, 3, 195 (March 1960).

The advantages and limitations of cast steel molds are given.

"Two New Machines for the Production of Deep-Drawn Plastics Packages," E. Escales, KUNSTSTOFFE, 50, 4, 219 (April 1960).

Description of two new machines for continuous and rotational production of semi-rigid packages, cups, or similar articles.

"Automatic Buffing and Polishing of Lacquered Surfaces," W. Burkhart, KUNSTSTOFFE, 50, 4, 257 (April 1960).

Description of some automatic machines and recently-introduced auxiliaries, with special reference to polyester-based lacquers.

"A New Extruder with Short, Slowly-Moving Screw," P. Seeber, KUNSTSTOFFE, 50, 4, 261 (April 1960).

Description of a new extruder designed to operate with highly viscous materials such as unplasticized PVC. The screw has short-cut flights having a low lead and considerably increased screw core diameter.

Applications

"Heat-Shrinkable and Polymer-Coated Polyester Films," Paul Stephan, SPE J., 16, 5, 545 (May 1960).

A modified version of polyester film laminate has applications in food packaging.

"Urethanes in the Shoe Industry," G. A. Baseden, SPE J., 16, 5, 548 (May 1960).

A RETEC paper dealing with urethane usages for shoes.

"Classification of PVC Floor Coverings," E. Fortun, KUNSTSTOFFE, 50, 4, 221 (April 1960).

A classification system is attempted for the most popular types of coverings.

"Molybdenum Disulfide in Nylon for Wear Resistance," T. E. Powers, MODERN PLASTICS, 37, 10, 148 (June 1960).

Advantages of these materials in reducing wear resistance.

"Plastic Materials and Construction in Nozzle Development," E. M. Gilchrist, WESTERN PLASTICS, 7, 6, 17 (June 1960).

The current status of work on solid-propellent rocket engine nozzles.

General

"Dusseldorf—An Assignment," C. W. Welch, TRANS. PLASTIC INST., 28, 74, 74 (April 1960).

A brief report on the Dusseldorf Plastics Exhibition in 1959, with some notes on the status of West German industry.

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Colors ..... /lb. .335 / .57
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Colors ..... /lb. .30 / .535
8640 ..... /lb. .32 / .555
8539, black, white, natural, grey ..... /lb. .305 / .54
Colors ..... /lb. .335 / .57
8738, black, white, natural ... /lb. .32 / .555
Colors ..... /lb. .37 / .605
8749, 8847, 8848, 8849 .. /lb. .25 / .485
8812, 8813, 8814, 8815, black, white, nat. /lb. .2875 / .5225
Colors ..... /lb. .3175 / .5525

CALENDAR of COMING EVENTS

September 8-9
SPE Eastern New England Section RETEC. Vinyl Plastics and Plastics in the Shoe Industry. Statler-Hilton Hotel, Boston, Mass.

September 11-16
American Chemical Society. 138th National Meeting. New York, N. Y.

September 22
SPE Binghamton Section RETEC. Plastics in Business Machines. Sheraton Inn, Binghamton, N. Y.

September 27-29
Technical Association of the Pulp and Paper Industry. Eleventh Annual Testing Conference. Pantlind Hotel, Grand Rapids, Mich.

October 5
SPE Golden Gate Section RETEC. Plastics vs. Corrosion. Mark Hopkins Hotel, San Francisco, Calif.

October 6-7
National Association of Corrosion Engineers. Regional Meeting. Sheraton-Palace Hotel, San Francisco, Calif.

October 9-12
ASME Rubber and Plastics Conference. Lawrence Hotel, Erie, Pa.

October 13-14
SPE Sixteenth Annual New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N. H.

October 14-23
French Packaging Institute. First International Packaging Machinery Show, Autopac 1960. Paris, France.

October 17-19
International Congress, 1960, on the Technology of Plastics Processing. Royal Institute for the Tropics, Amsterdam, Holland.

October 17-19
Technical Association of the Pulp and Paper Industry. Fifteenth Plastics-Paper Conference. Hotel Syracuse, Syracuse, N. Y.

October 19-26
International Plastics Exhibition macroPlastic 1960. Exhibition Grounds, Utrecht, Holland.

October 25-27
American Standards Association. 11th National Conference on Standards. Sheraton-Atlantic Hotel, New York, N. Y.

November 7
SPE Ontario Section RETEC. Automation in Injection and Compression Molding. King Edward Sheraton Hotel, Toronto, Ontario, Canada.

November 18
SPE Newark Section RETEC. Blow Molding Comes of Age. Essex House, Newark, N. J.

November 30-December 2
British Plastics Federation. International Reinforced Plastics Conference. Cafe Royal, London, England.

November 30-December 2
U. S. Army Signal Research and Development Laboratory. 9th Annual Symposium on Technical Progress in Communication Wires and Cables. Berkeley-Carteret Hotel, Asbury Park, N. J.

Domestic Production and Sales of Plastics and Resin Material, March and April, 1960

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of March and April, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	March, 1960		April, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,622,970	1,736,488	1,236,225	1,484,559
Sheets, 0.003 gage and over	2,046,348	1,987,503	1,801,670	1,702,041
All other sheets, rods, and tubes (including other cellulose plastics)	1,033,575	1,044,176	617,873	890,620
Molding and extrusion materials (including other cellulose plastics)	9,611,323	8,826,885	7,466,819	7,906,658
Nitrocellulose sheets, rods, and tubes	249,294	144,464	.....	121,142
TOTAL	14,603,510	13,739,516	10,909,072	12,105,020
Phenolic and Other Tar-Acid Resins:				
Molding materials	22,146,677	18,189,140	18,175,619	16,753,090
Bonding and adhesive resins for—				
Laminating (except plywood)	6,462,038	3,929,619	5,543,346	3,727,147
Coated and bonded abrasives	1,799,585	1,609,580	1,145,094	1,024,622
Friction materials (brake linings, clutch facings, and similar materials)	1,489,685	1,024,507	962,263	1,019,738
Thermal insulation (fiber glass, rock wool)	3,573,805	3,562,864	2,768,485	2,797,187
Plywood	4,788,845	3,504,800	4,416,766	3,411,965
All other bonding and adhesive uses	6,243,726	5,830,803	5,863,456	5,624,100
Protective-coating resins unmodified and modified except by rosin	3,071,339	2,075,352	2,361,494	1,889,323
Resins for all other uses	5,015,933	3,809,798	4,264,543	4,013,920
TOTAL	54,581,633	43,536,463	45,501,066	40,193,092
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,042,044	2,815,680	2,607,884	2,383,029
Paper-treating and paper-coating resins	2,749,158	2,427,310	2,619,776	2,096,327
Bonding and adhesive resins for—				
Laminating	3,124,793	2,514,582	3,392,566	2,385,153
Plywood	8,801,462	8,906,454	8,637,892	8,040,047
All other bonding and adhesive uses	1,722,055	1,741,363	2,766,105	2,577,335
Protective-coating resins, straight and modified	2,538,090	2,581,633	3,230,629	1,933,971
Resins for all other uses, including molding	12,136,267	11,257,429	10,878,338	10,529,518
TOTAL	34,113,869	32,244,451	34,133,190	29,945,380
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	25,573,505	21,811,561	23,661,082	20,858,730
All other	31,874,094	27,804,980	30,142,332	26,861,808
Protective-coatings	6,686,636	6,302,197	6,101,953	6,173,064
Textile and paper treating and coating resins	6,140,106	4,798,707	5,411,678	4,645,135
All other uses	15,848,736	21,554,755	13,624,447	18,827,680
TOTAL	86,123,077	82,272,200	78,941,492	77,366,417
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		9,105,658		8,271,514
Sheeting (resin content)		10,293,914		10,814,839
Molding and extrusion (resin content)		25,662,952		22,834,824
Textile and paper treating and coating (resin content)		5,126,631		5,156,850
Flooring (resin content)		14,717,930		12,811,206
Protective coating (resin content)		3,171,370		3,431,385
All other uses (resin content)		9,509,584		8,482,272
All other vinyl resins for—				
Adhesives (resin content)		6,149,273		4,796,747
Protective coatings (resin content)		2,386,795		2,455,298
All other uses (resin content)		12,264,889		10,188,586
TOTAL	108,263,145	98,388,996	98,122,171	89,243,521
Coumarone-Indene and Petroleum Polymer Resins	19,993,248	20,717,626	19,688,931	19,800,166
Polyester Resins:				
For reinforced plastics	14,141,447	11,975,231	13,619,494	11,360,686
For all other uses	2,293,760	2,356,098	2,414,115	1,956,012
TOTAL	16,435,107	14,331,329	16,033,609	13,316,698
Polyethylene Resins:				
For film and sheeting		30,706,640		32,056,509
Molding materials		14,890,133		15,460,051
Extrusion materials		13,539,626		13,363,423
For all other uses		41,633,017		38,393,936
TOTAL	114,565,508	100,769,416	114,018,792	99,273,919
Epoxy Resins:				
For protective coatings		1,967,932		1,530,118
For all other uses		2,295,224		2,742,146
TOTAL	5,325,970	4,263,156	6,581,287	4,272,265
Miscellaneous Synthetic Plastics and Resin Materials, Including Silicone Resins	25,905,929	22,744,297	24,822,391	20,874,036
GRAND TOTALS	479,910,668	433,007,450	448,762,101	406,390,514

SOURCE: United States Tariff Commission, Chemical Division.

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